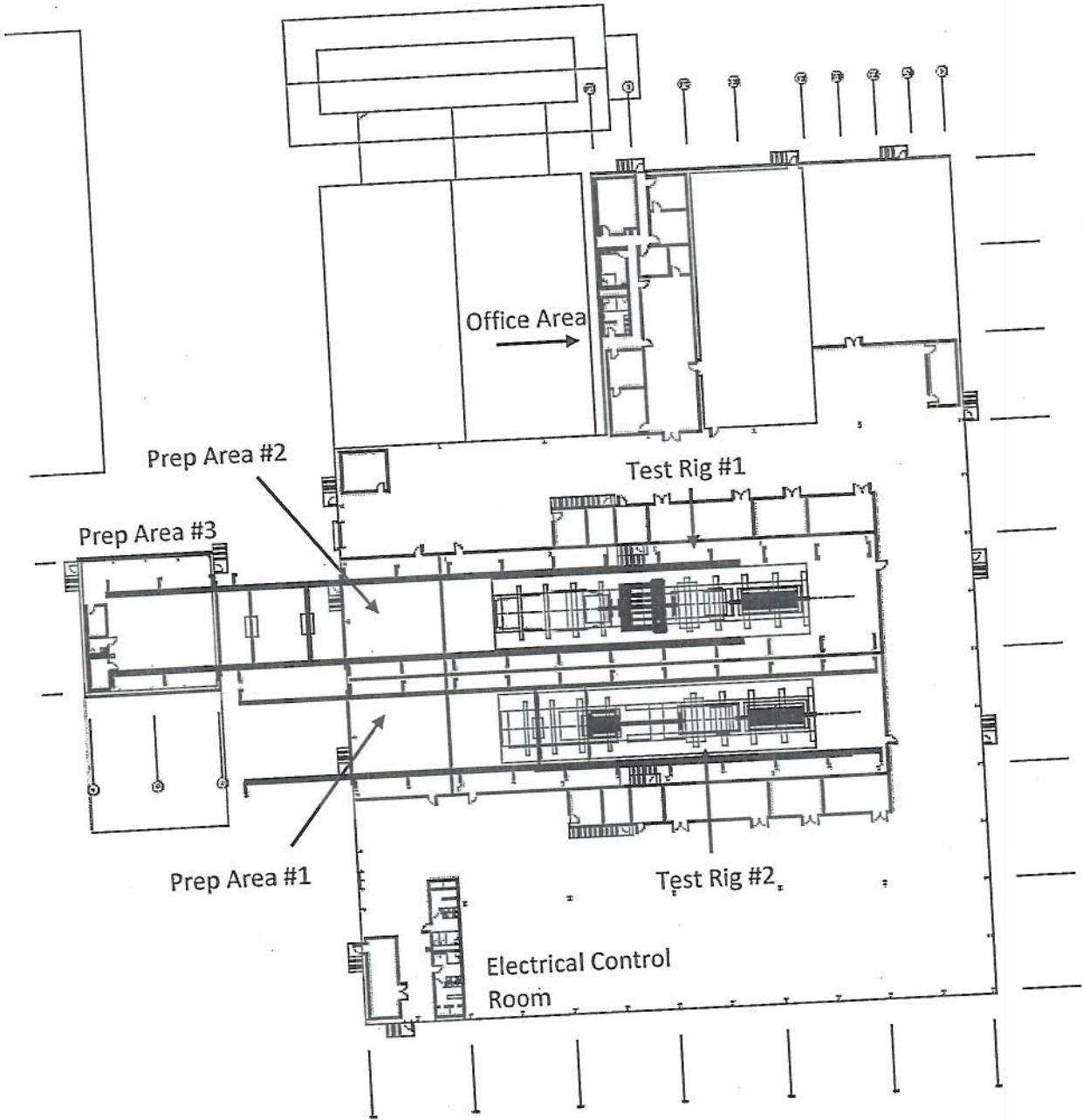


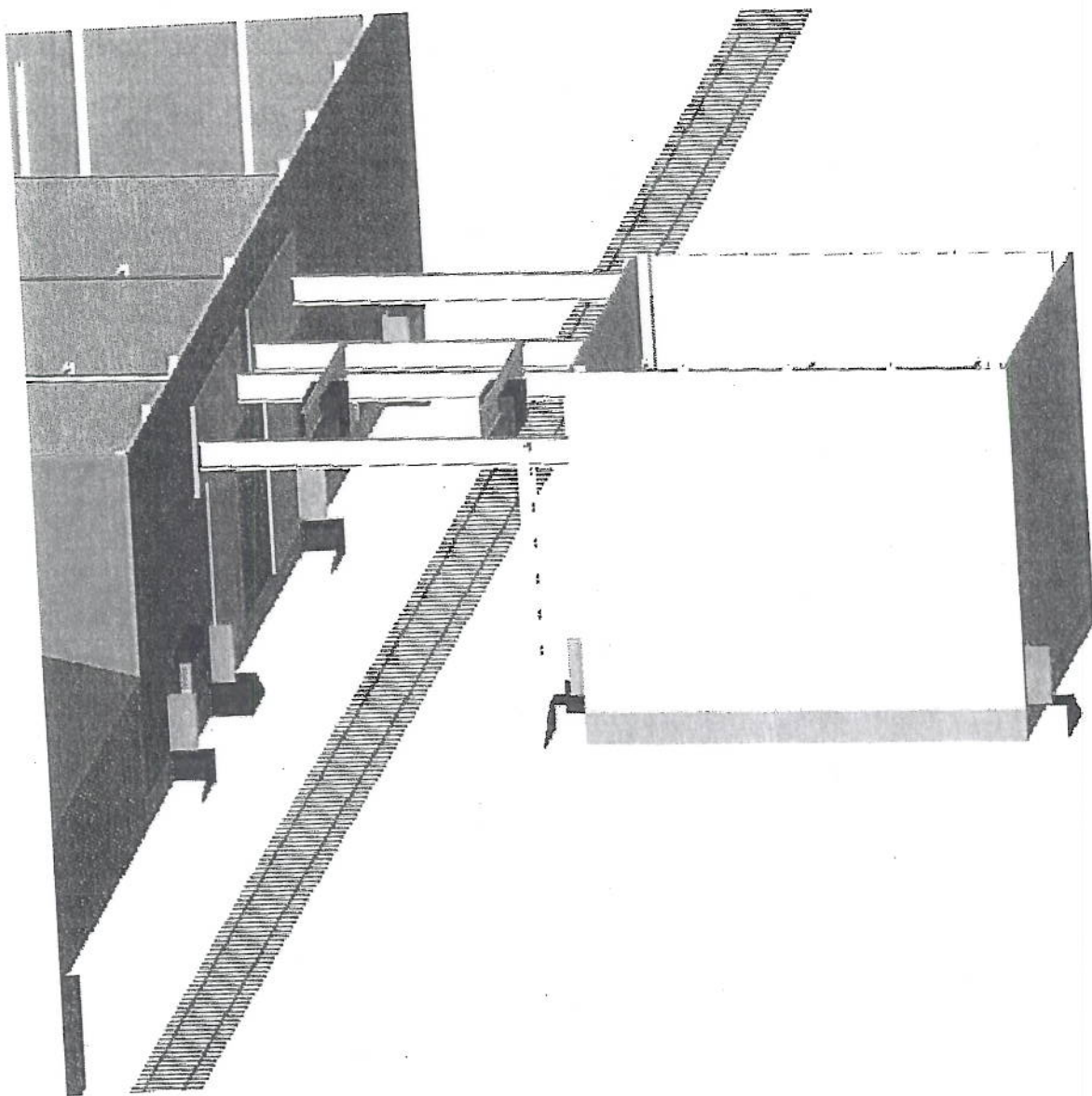
APPENDIX K

BUILDING 69 MODIFICATIONS SCHEMATICS AND DRAWINGS

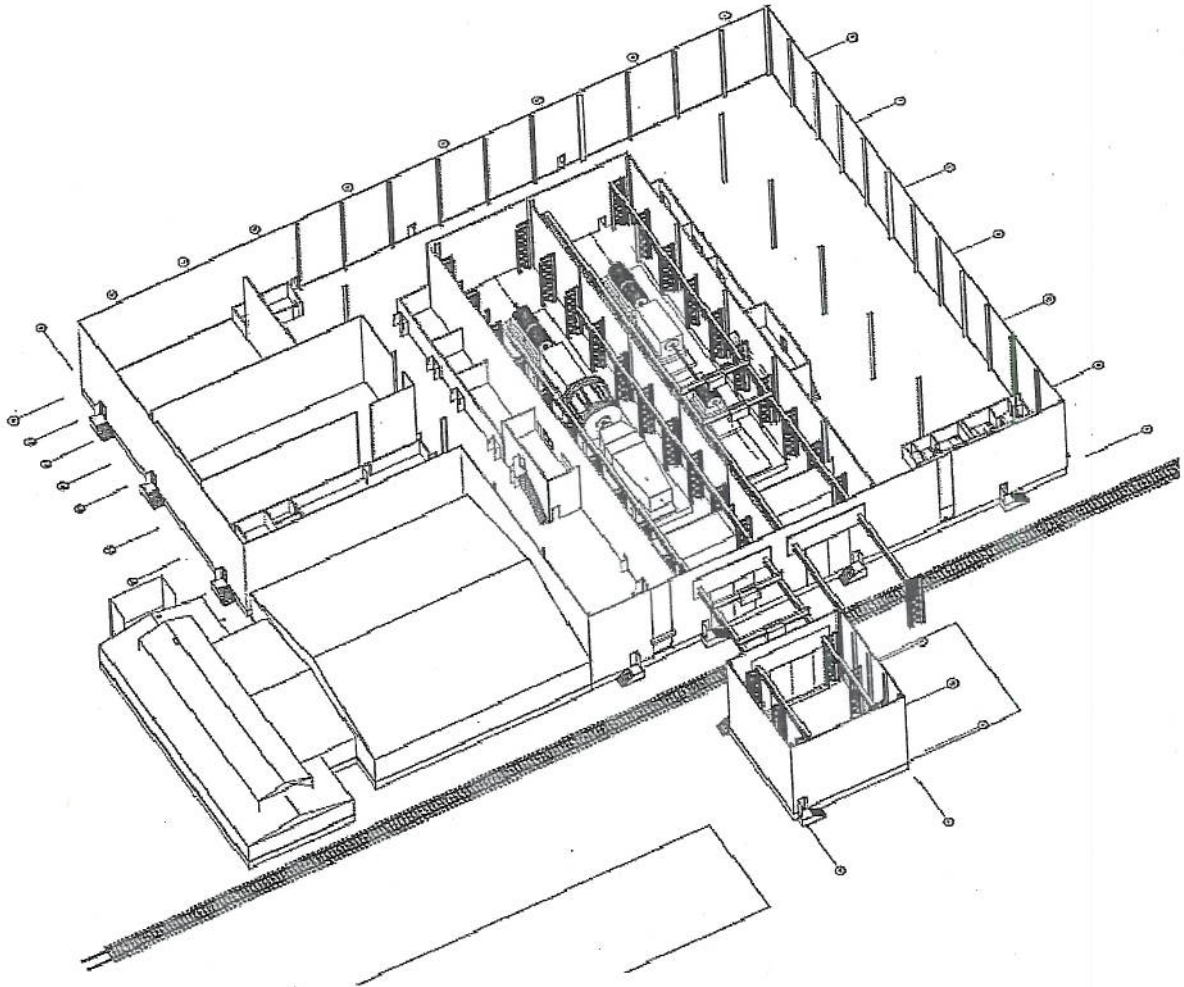
Building 69: Layout



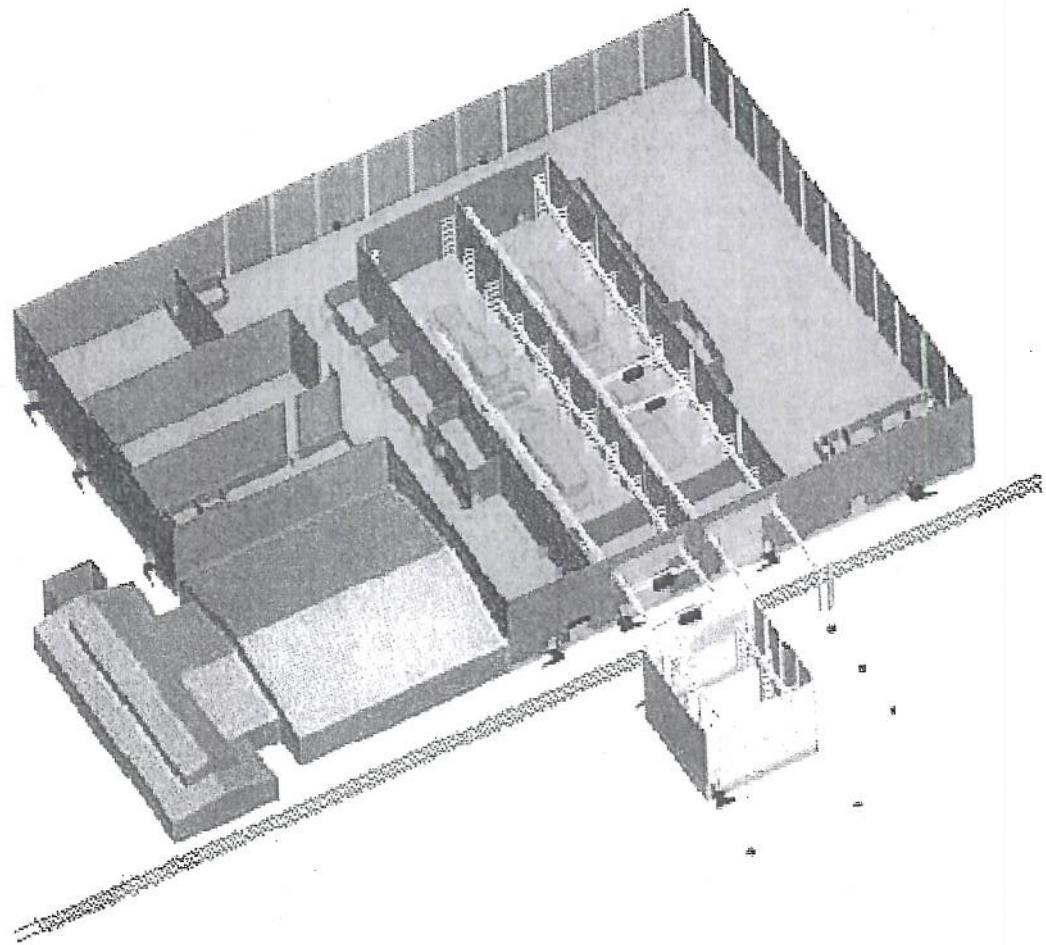
Building 69: Prep Area #3, Railroad Spur Extension and Crane Gantries



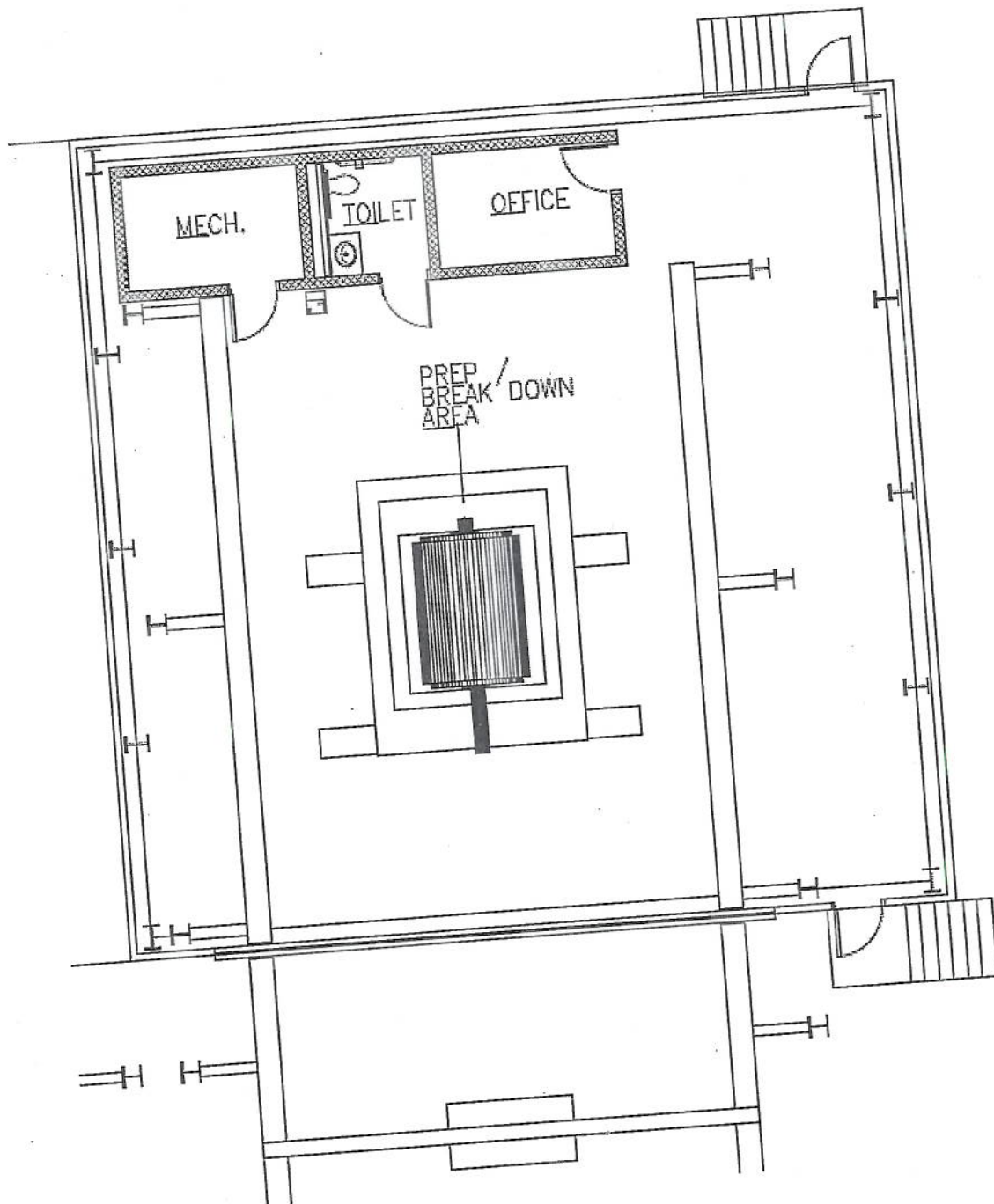
Building 69: Aerial View of Layout

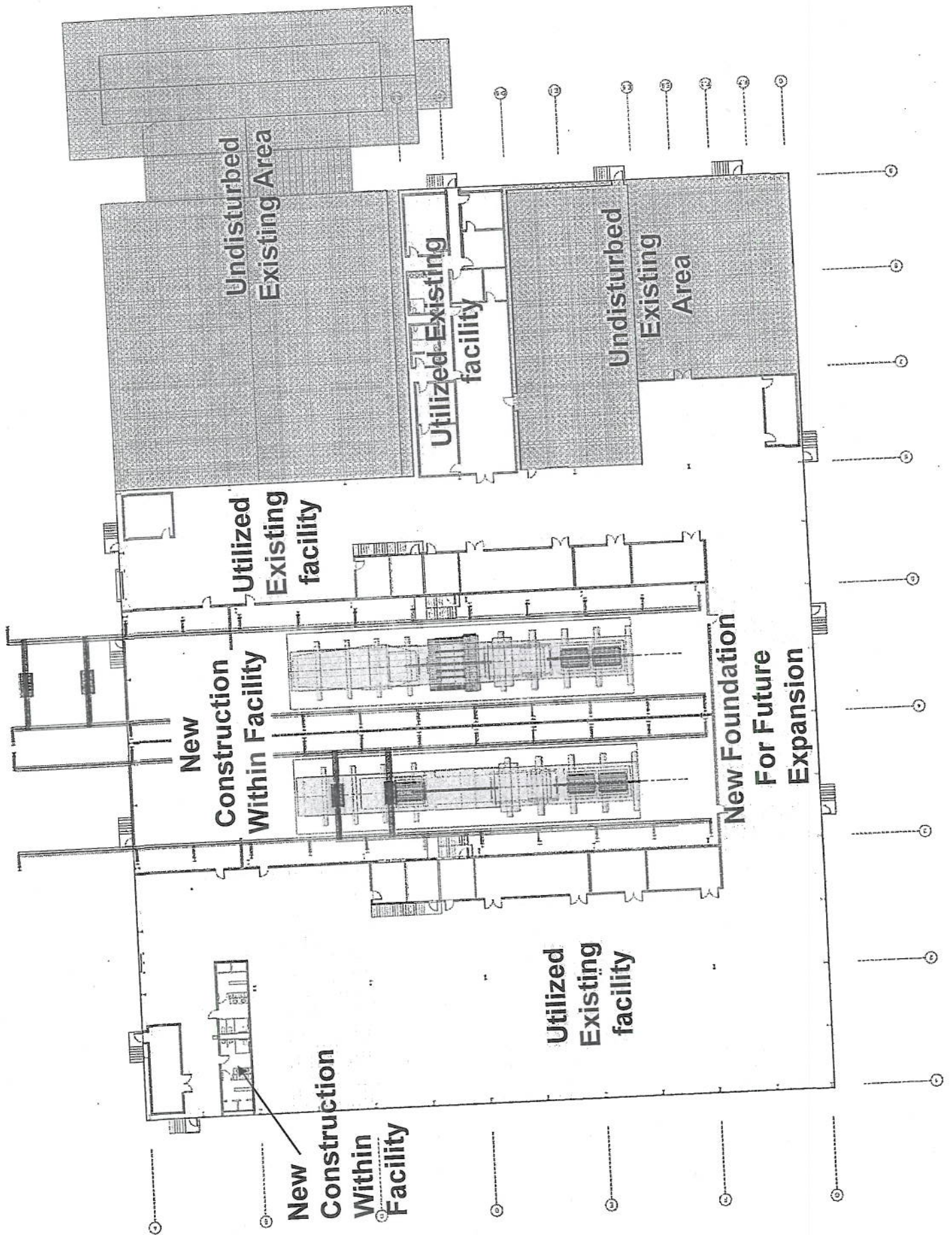


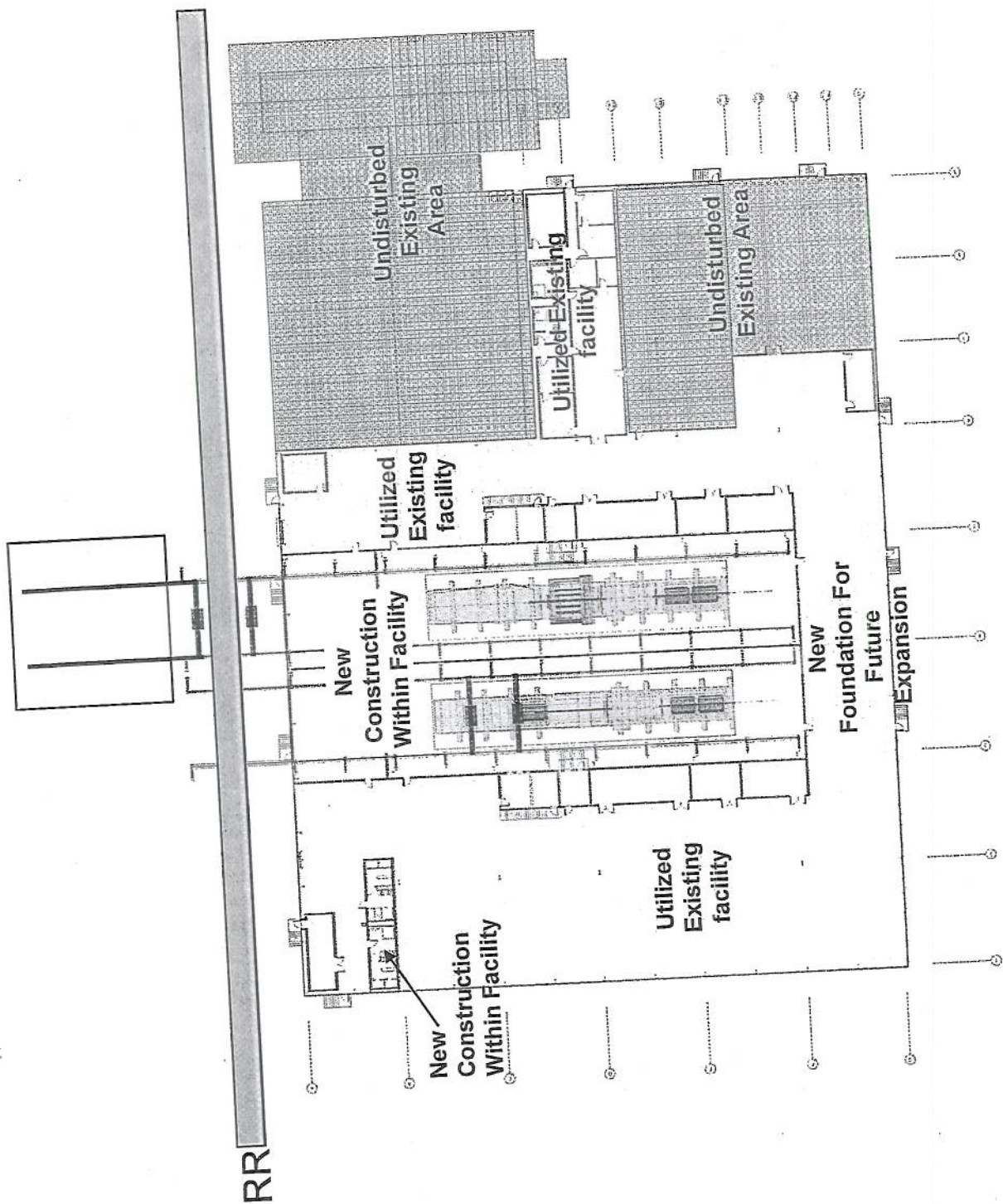
Building 69: Color Schematic of Aerial View

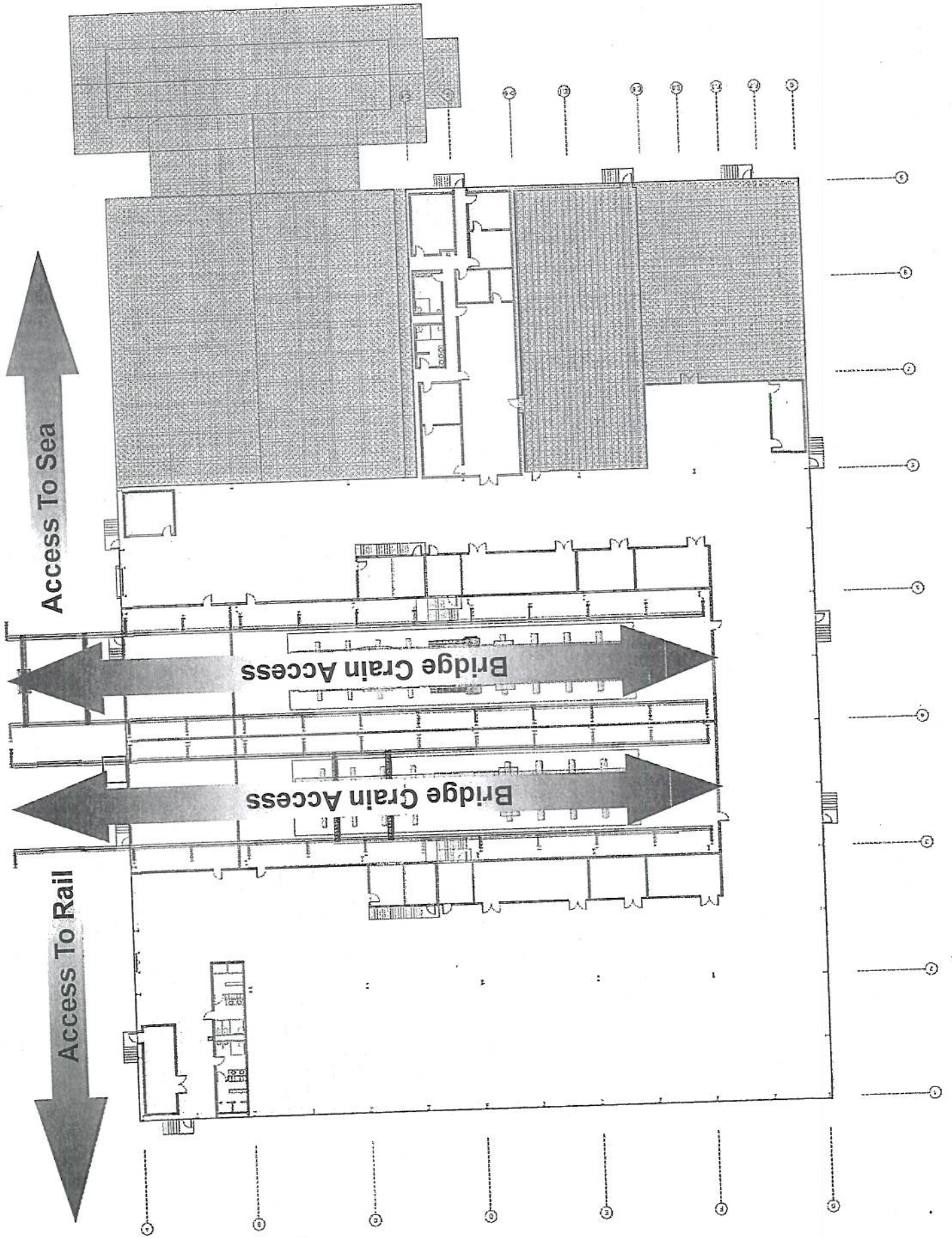


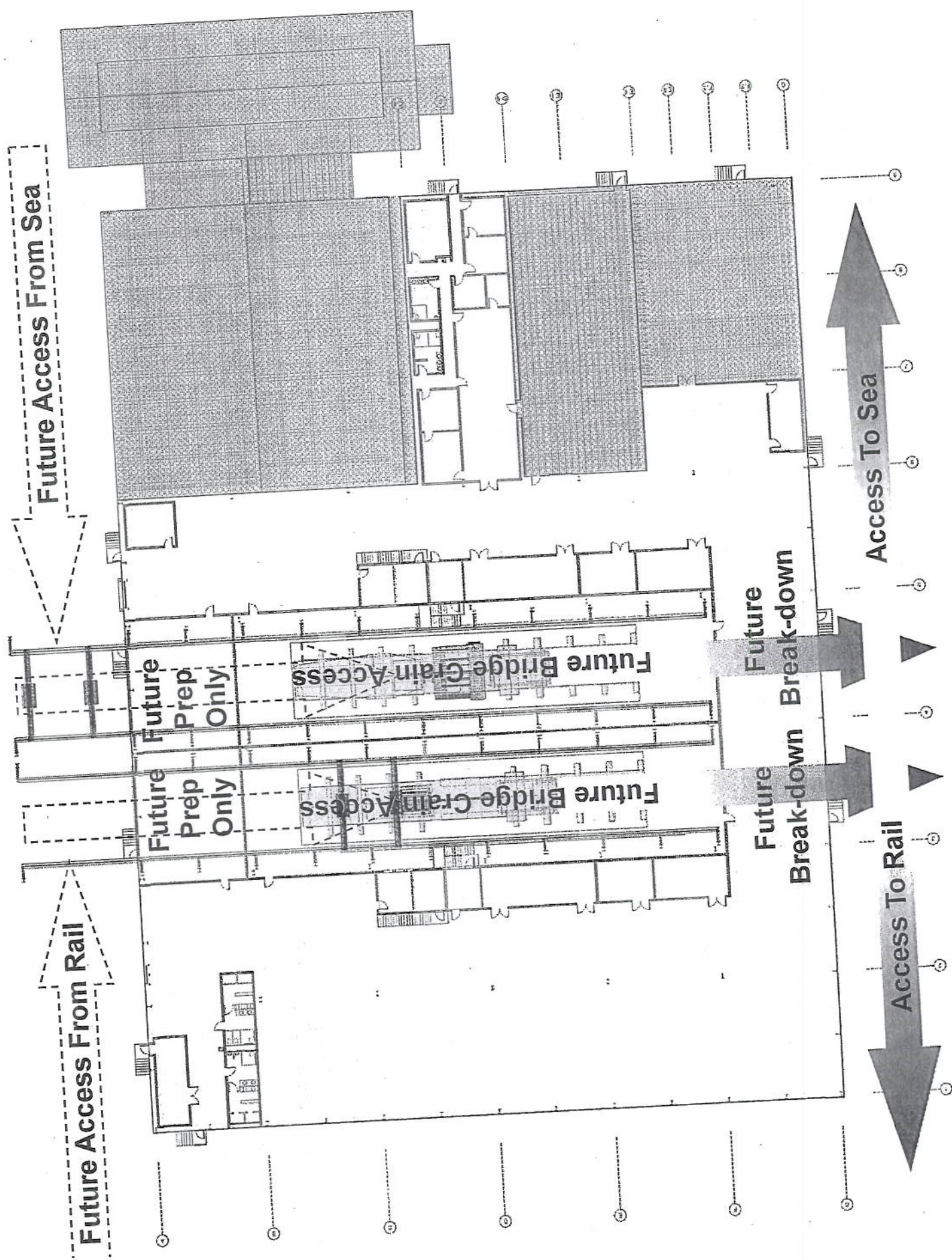
Building 69: Layout of Prep Area #3

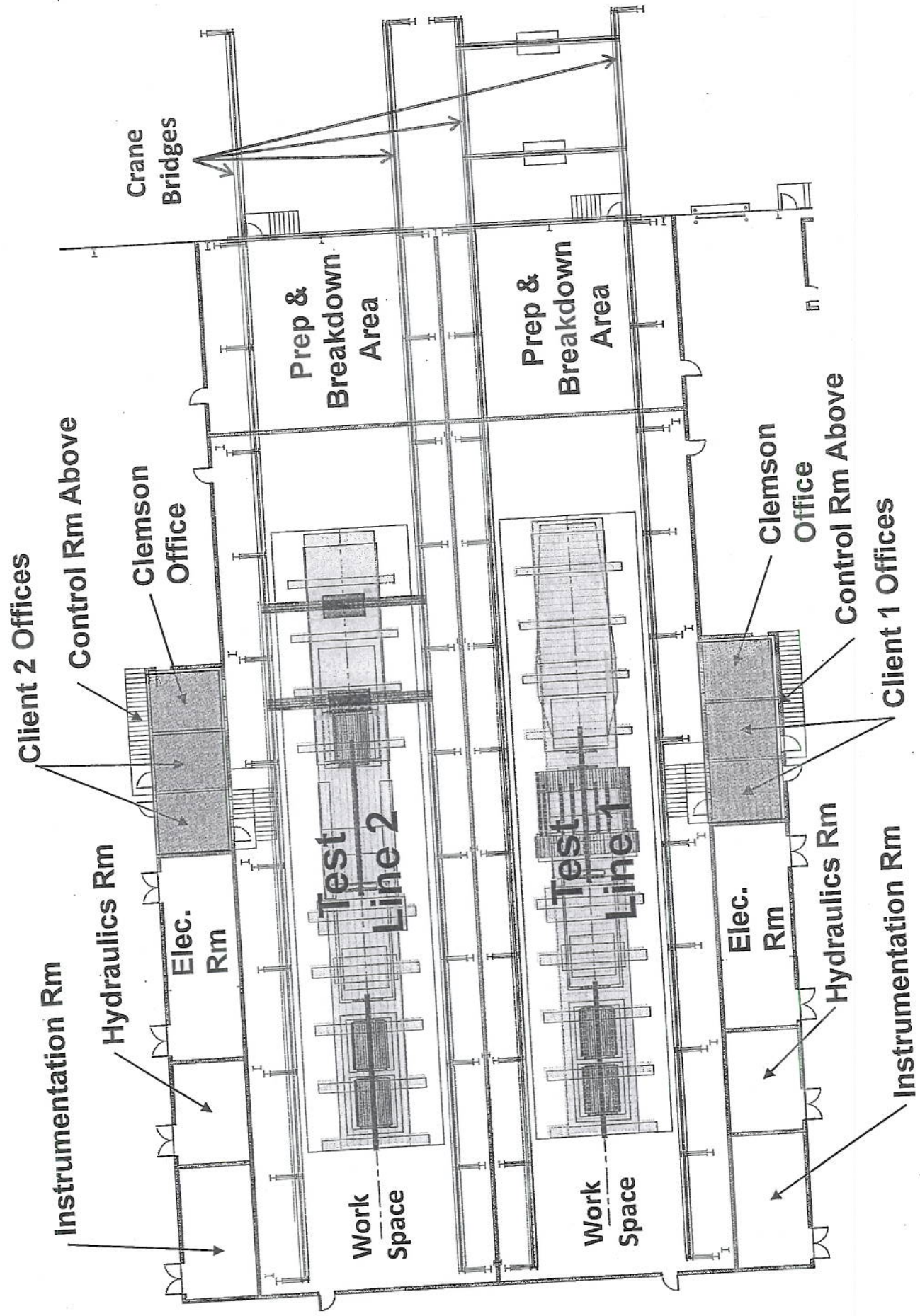


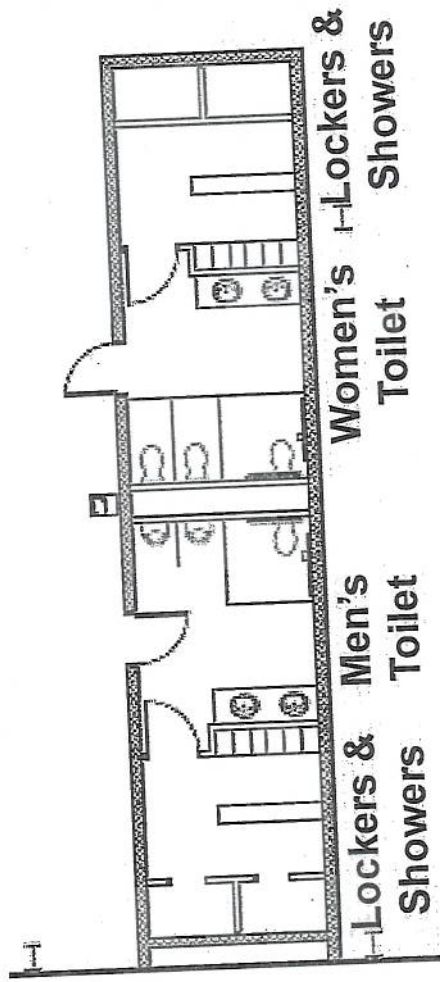




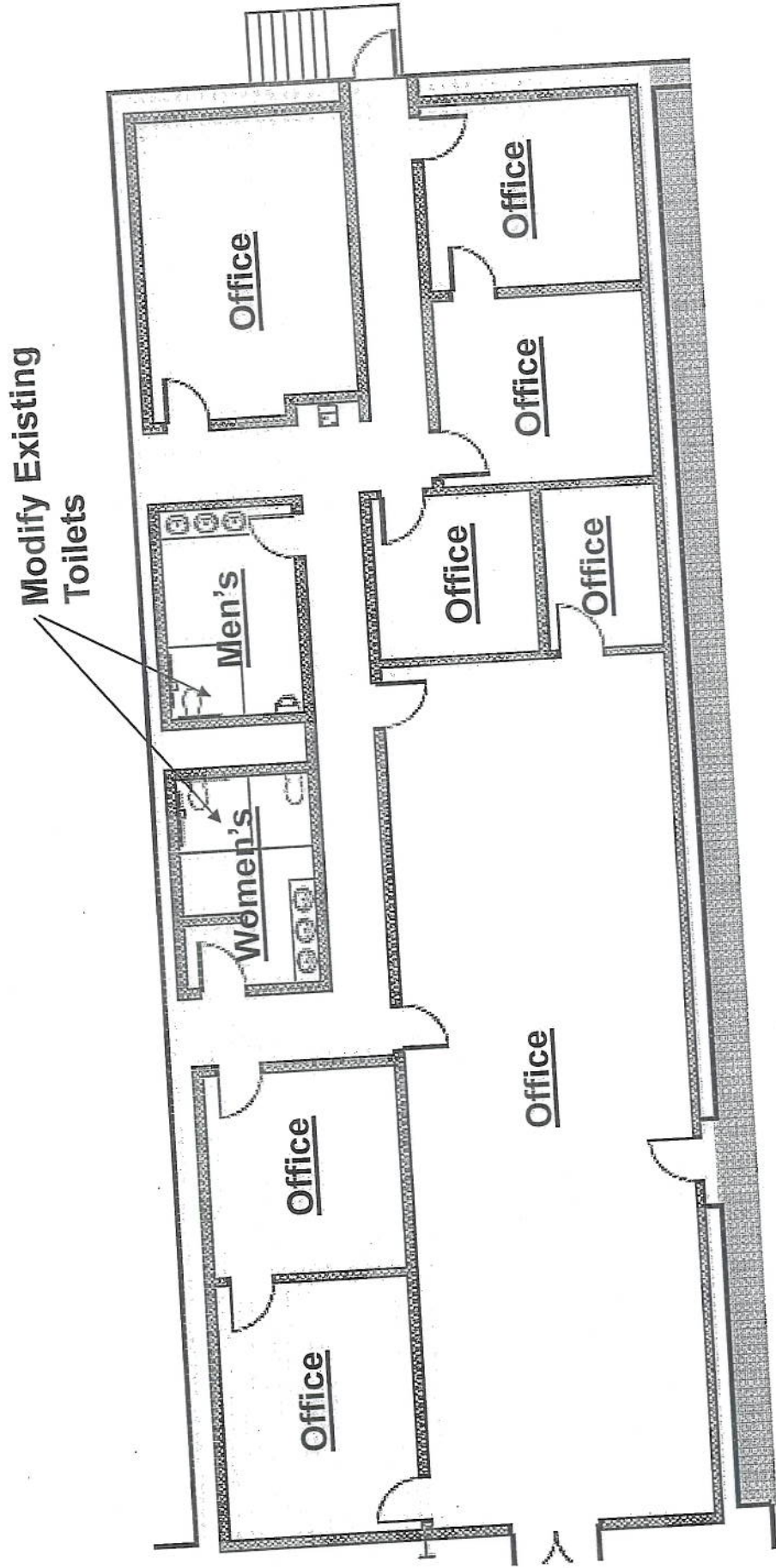








New Toilet Facilities



Office
(& temporary construction offices

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1.0 PROJECT OBJECTIVES:

1. Design, develop, and construct a unique state-of-the-art facility (*The Clemson University Wind Turbine Drivetrain Test Facility (CU WDTDF)*) that permits full-scale highly accelerated life testing (HALT) of advanced drivetrain systems for wind turbines up to 15MW with a 30% overload capacity. The project ensures availability and access to drivetrain and wind turbine manufacturers for utilization on a commercial basis of an advanced HALT facility, and will generate new knowledge that will lead to improved designs with increased reliability and lower cost of energy (COE) to meet the 20% Wind by 2030 Scenario¹ objectives.

2. Meet the objectives of the American Recovery and Reinvestment Act of 2009 by creating jobs in an economically distressed area of US and assist in the economic recovery in an expeditious manner.

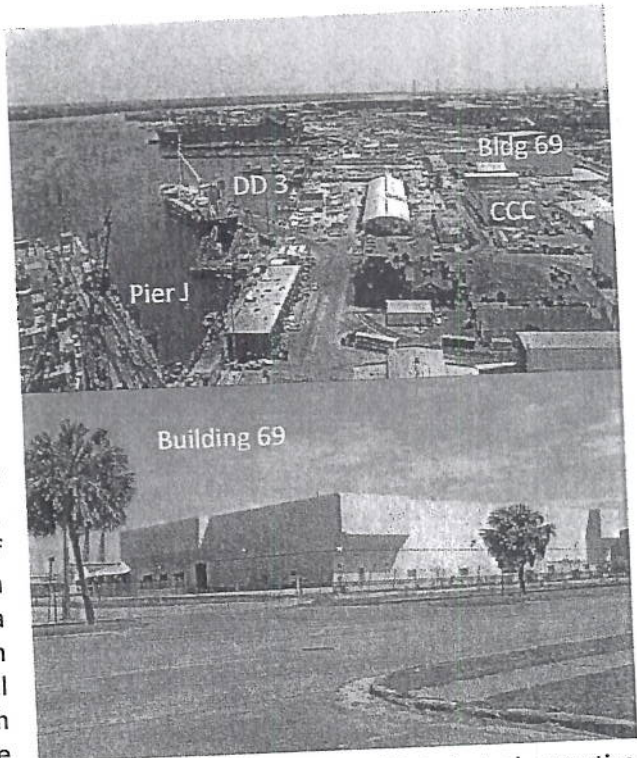
2.0 MERIT REVIEW CRITERIA DISCUSSION

2.1 Criterion 1: Technical Merit

2.1.1 Adequacy of Facility and Planned Test Program

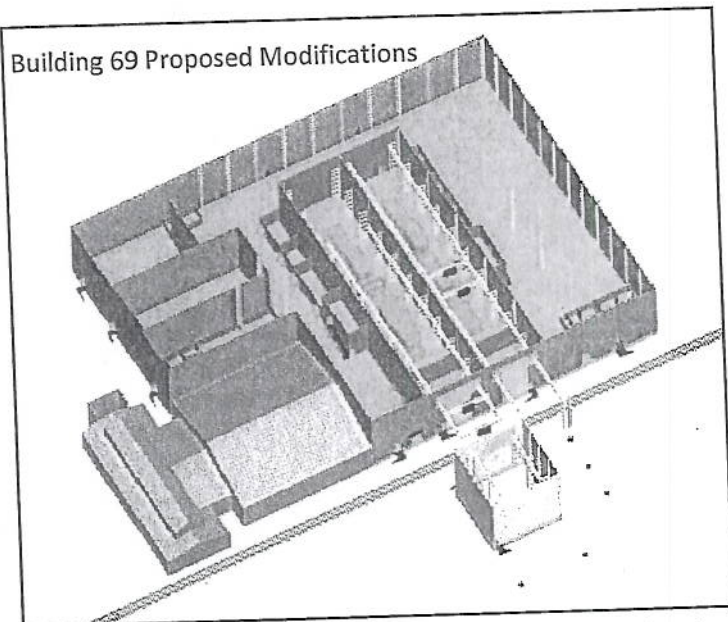
The proposed facility will be built at the former U.S. DOD Charleston Naval Complex (CNC) in North Charleston, SC which was decommissioned in 1996. Building 69, a former Navy warehouse adjacent to existing rail and ship handling infrastructure and the Clemson University Restoration Institute (CURI), was chosen as the optimal site.

The test plan for the proposed site includes building two test dynamometers with one having the capability of testing drivetrains and generators up to 15MW coupled to a Blade Force Simulator and the second having the capability of testing up to 7.5MW drivetrains and generators. Both dynamometers will have the capability of testing up to 30% overload capacity and run simultaneously. The facility will be operated as a non-profit business venture with oversight from an Industrial Advisory Board (IAB) and Technical Advisory Board (TAB) to provide high value/high quality HALT services to industry at a competitive price. The facility will be designed to allow for maximum flexibility and staffed with technical expertise, engineers, operators, and technicians who will work closely with each customer on their respective test plan needs. Procedures and policies will be developed to ensure the safe operation of the facility. Additional support services from existing industry at the CNC will be available to customers including heavy equipment movement beyond 300 tons, rigging, logistics, machining and analytical testing. The 'shared' facility model being proposed is designed to provide end-users the flexibility, security, confidentiality, and capabilities needed to meet current and future test needs while providing access to researchers, students, and existing analytical and testing capabilities.



2.1.1.1 Facility Upgrades

Building 69 was built in 1942, modified in 1985, and decommissioned in 1995. It served as the main warehouse for the Navy's storage of non-hazardous materials. The building stands on 6.3 acres of fenced-in property with plenty of room for lay down of equipment. The building is 82,264 ft² providing significant space for the installation of test cells and creation of three (3) staging areas for preparation of test articles before and after testing. It is anticipated that only 52,000 ft² will be used for the test facility, leaving 30,000 ft² for future growth. The ceiling height is 42 ft, giving adequate space for crane-way systems to be installed and the handling of direct-drive units.



Building 69 has existing infrastructure to support lighting and ventilation needs. Building modifications will include construction of two large foundations for the test drive equipment, installation of four 150-ton bridge cranes with associated crane girders and framing to form two 300-ton crane-way systems, three preparation areas, supplementary works spaces around the test rigs, and construction of 7,000 square feet of conditioned operating areas. More detailed drawings and renderings can be found in Section 4 and Appendix K of the Project Management Plan.

The two large equipment foundations and heavy bridge crane loads require a portion of the building slab to be removed (approximately two bays) with pilings put in place to distribute the anticipated loads. The gantry cranes will extend approximately 40 ft. out of the building straddling the rail spur extension with one extended into the 3rd preparation area building. This will facilitate movement of equipment into the building for set-up and onto the test rigs. SC Public Railways will construct a rail spur from an existing switch west of the building that will run along the side of Building 69 under the crane gantries and to the head of Dry-Dock 3. A 3rd preparation and breakdown area will be constructed adjacent to the building. Safety equipment and equipment to power hydraulic systems, climate chambers, a cooling tower for heat removal from the test rigs, compressed air, climate control in select areas, data acquisition systems, tools for mechanical and electronic system repair, and forklift trucks for moving small components will be leased from CMMC depending on size requirements.

Offices for customers, operators, technicians and test engineers, a break room, an instrumentation preparation room and toilets will also be provided. Details of the estimated costs and the assumptions are shown in the project management plan. Additional office space, video conference rooms, and facilities are available to visiting customers and scientists at the adjacent Clemson Conservation Center (CCC).

2.1.1.2 Test Program

It is clear from the numerous studiesⁱⁱ that drivetrain integrity is one of the key factors in improving reliability and performance of wind turbines. Therefore, the primary focus of the test program will be on

HALT and HALT to failure for prototype and production wind turbines up to 15MW. Since turbine design and testing procedures are proprietary, test plans will be developed in collaboration with the client. The dynamometers envisioned for this facility have the ability to test drivetrains and generators up to 15MW capacity with 30% overload and simulate real world conditions including temperature variations and the application of loads to the main shaft of the test drivetrain that simulates actual blade forces experienced in the field. As a recognition of the fact that most drivetrain designs are proprietary, the test programs envisioned to be conducted at this facility will have three parts: 1) Proprietary commercial testing of drivetrains with specific outcomes as determined by the client in consultation with the technical staff, 2) collaborative research between Clemson University and individual manufacturers with the goal to improve reliability and performance through the use of advanced materials, improved manufacturing processes and metrology, model development and validation, and drivetrain design to mitigate vibration, failure and fatigue, and 3) testing in support of government-university-industry and other collaborations with a focus on drivetrain reliability and performance. The primary mission of this facility will be proprietary commercial testing of drivetrains, generators, and nacelles for the industry.

With the objective to accelerate the development of advanced drivetrains, strong efforts will be made to foster collaborations with industry and government to continuously improve HALT test protocols and analysis tools resulting in a more in-depth understanding of failures in drivetrains. These collaborative efforts will involve not only wind turbine manufacturers but also Tier 1 and other suppliers (for example bearing manufacturers).

2.1.2 Adequacy of Building Infrastructure to Accommodate Transportation Logistics etc.

Building 69 is strategically positioned next to Pier J (operated by CMMC) and Dry Dock 3, owned by the CURl. Pier J is 750 ft. x 80 ft., has a depth of 35 ft. at low tide and is accessible through a 45 ft. MHW shipping channel. Off-loading of large turbines and drivetrains up to 500 tons from ships is available at Pier J using J. E. Oswalt and Son's 500 ton crane barge that currently services the port. The units arriving by ship will be picked up by Oswalt from Pier J and transported directly to the head of Dry Dock - 3 which is permanently flooded - where they will be

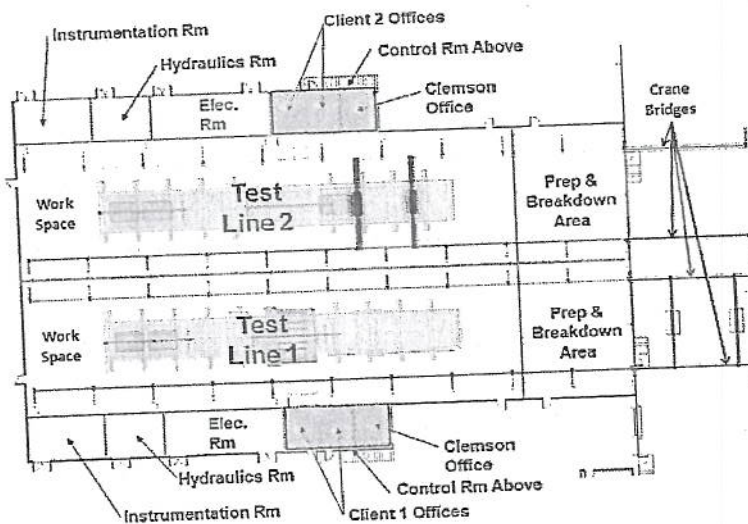


loaded on to a railcar and moved 500 ft. west to Building 69 for movement into the building. Equipment arriving at the nearby Cooper River or Wando Terminals operated by the South Carolina State Ports Authority would be moved to the test facility through delivery using the Oswalt crane barge and Dry Dock 3 as described above. Equipment arriving by rail would be off-loaded adjacent to Building 69. The Charleston Naval Complex is easily accessible by interstate and is currently serviced by numerous truck movements. Major roads in the complex are capable of handling overweight vehicles. CMMC in cooperation with Detyens Shipyard and J.E. Oswalt & Sons Crane Services will provide pass through services to customers to meet their equipment logistics, handling, and rigging requirements. Additional support can be provided by CMMC and Detyens Shipyard to facilitate customers' needs including machining services, welding, electrical, and equipment breakdown. CMMC Machine is housed in a 134,000 sq. ft. facility just 200 yards north of Building 69. CMMC Machine has more than 150 machine tools which provide complete machining capabilities for the most demanding applications including all

precision machining needs within .0005 inches. These services will be managed by the Facility staff for the customers.

2.1.2.1: Building Layout

The proposed facility consists of a side-by-side configuration of the two test rigs (Test Rigs 1 and 2), preparation and breakdown areas, and office space for operators, customers, and engineers present in the facility. Rooms for instrumentation preparation and test rig control are also provided. Future plans include the addition of a breakdown area at the south end of the facility. More details are provided in Appendix K of Project Management Plan.



2.1.3 Adequacy of Proposed Electrical Infrastructure

Power will be supplied to the test facility by South Carolina Electric and Gas (SCE&G) through their 115kV transmission system and stepped down to a utilization voltage of 4160V or higher, depending on final design parameters. The transmission line will be constructed by SCE&G and a substation built at the site to provide uninterruptable power. The power provided to the test rigs will be converted from AC to DC before being utilized. This conversion serves multiple purposes that include (1) Isolation from the utility so that intentionally introduced disturbances on the generating unit under test are not propagated back into the host utility grid, (2) Variable speed output can be easily created utilizing variable frequency drive controllers for the dynamometer input drive motors allowing the unit to adjust to a wide range of wind turbine sizes, (3) Both 50Hz and 60Hz wind turbines may be tested with the same dynamometer so that generating units designed for use anywhere in the world may be accommodated and (4) Energy output from the generating unit under test can be easily recycled without interacting with the host utility grid by converting the power back to DC. This model allows a unit under test that is not compatible with North American standards to still recycle power because it is converted to DC and the need for a special protection plan and equipment required for a unit that operates in parallel with the local utility is eliminated. (See Appendix E in Project Management Plan)

Once DC power is created it supplies the variable speed drives in the dynamometer. The dynamometer simulates the wind input for wind turbines or other prime mover inputs for literally any generating unit under test. The output power from the generating unit under test is operated in parallel with the simulated utility grid where its outputs are monitored for performance against design parameters.

At the beginning or end of a test cycle, the simulated grid power is created by converting power from the DC bus back into the operating AC frequency of the unit under test, either 50Hz or 60Hz. This power supplies the auxiliary controls and supporting equipment in the unit under test and provides a source for the unit to synchronize and parallel. Once the unit under test is in operation and producing power, the direction of power flow in the converter feeding the simulated grid reverses and the power

from the unit is fed back to the DC bus. In this state of operation, the host utility is only supplying power to replace losses in the system. The power conversion unit between the DC bus and the simulated grid is modulated to simulate grid disturbances under certain test sequences. This allows for direct measurement of all responses in the unit under test as well as its supporting equipment.

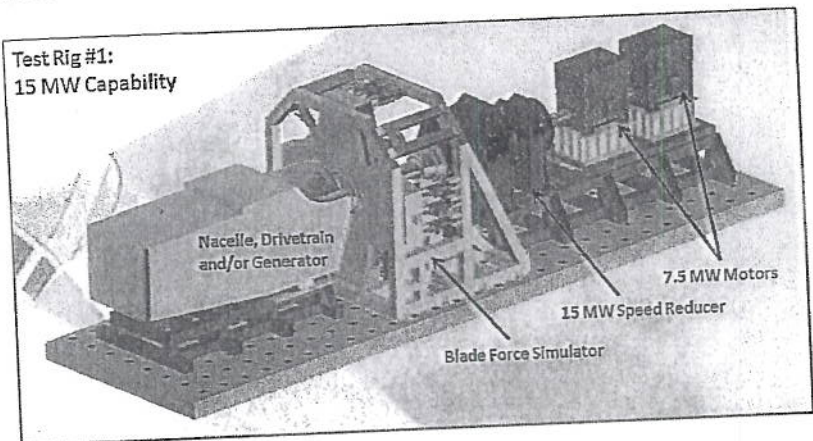
The electrical system includes a simulated grid fault system designed for IEC 61400 -12-1, IEC 61400 – 21 testing. The purpose of this system is to test the response of the test unit and its auxiliary equipment to various fault scenarios. The most common concern for a wind turbine would be grid fault ride through verification, but this fault simulator also would be universal to other generating units. Output from the simulated grid power converter would be limited in these scenarios so as to not mask the characteristics of the unit under test. A grid simulation system has been designed that will be easily interfaced with proposed electrical infrastructure system and shown in Appendix E of the Project Management Plan.

2.1.4 The Dynamometer Test Stands

HALT is a methodology that is increasingly being used to determine reliability of products by subjecting them to temperature and loading conditions that identify the limiting failure modes of a product. The facility will consist of independent bays housing two (2) instrumented test rigs that can test complete drivetrains, gear boxes, nacelles, and high-speed and direct drive generators. Simultaneous testing of up to 7.5MW drivetrains will be possible. The rig configurations are described below. The rigs are equipped with independent drive systems. This design allows the use of standard components to create modular systems. Climatic chamber and acoustic insulation will be available on both rigs.

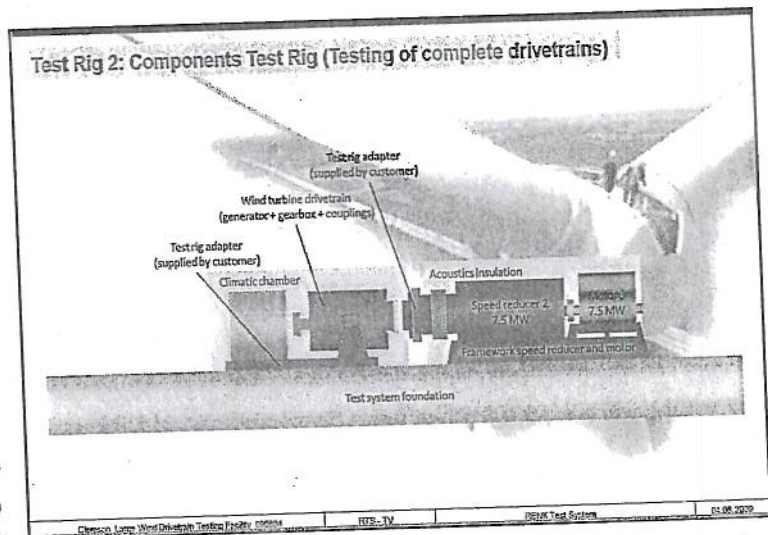
Test Rig #1 will be designed to perform HALT of up to 15MW drivetrains and generators. A unique feature of Rig #1 is the *ability to replicate the actual forces and moments from wind turbine blades seen in real life situations exerted on the drivetrain of a wind turbine.* The test rig will be equipped with a "Blade Force Simulator" that will apply loads to the main shaft of the specimen

drivetrain, replicating forces and moments along three orthogonal axes thereby simulating actual blade forces experienced in the field. The axial moment (torque) is created by the drive unit with all other loads introduced through the simulator system. Customers will have the ability to program the Blade Force Simulator to test under a variety of wind shear scenarios. The 15MW speed reducer gearbox used in Rig #1 is based on the general concept of high power wind turbine gearboxes with special modifications to manage the extreme torque at the gearbox's output shaft. The 15MW speed reducer gearbox is designed with respect to all loads resulting from the blade force simulation system and the flexible coupling. In order to achieve a compact test rig design the lubrication unit of the speed reducer gearbox is integrated into the gearbox design at both gearboxes.



Test Rig #2 will be designed with a 7.5MW speed reducer gearbox based on the design of an existing wind turbine gearbox with special features for the test rig (e.g. gear ratio and mount). The customer's equipment may be located in the same area or it may need to be located closer to the test article (e.g. if line impedances are an issue).

There are currently two (2) design options for the test bed construction. The first design option under evaluation has an inclined bed to accommodate the designs of the nacelles to be tested. The second option would be to custom build sub-frame structures to adapt the customers' nacelle test articles to the test rig framework. Both options will be reviewed with industry representatives before a final design is approved.



For design model validation, control, and power outputs (resulting from the fluctuating input loads) from the turbine are fed back into the test rig control system to validate operation and response of the complete test system. In this situation the test rig input power to the test article will be proportionally responsive to the control outputs provided by the turbine control system.

For investigation of failures from field data, the test system can be used as a semi-open loop system so that data gathered in the field can be used to access failure modes in the drivetrain. In this case, a power output signal, which is proportional to the input signal, would be fed from the test rig system into the converter equipment.

The Blade Force Simulation System (BFSS) is comprised of three sub-systems, one for applying the radial forces, one for applying the axial force, and one for applying the bending moments. Main components of the blade force simulation system are as follows: Central shaft, load disc with axial and radial bearings, hydraulics, load reaction block, measuring shaft, and flexible coupling. The load disc (non-rotating) is mounted on the central shaft by using axial and radial bearings. The central shaft is driven by the drive system and works as the direct interface of the test environment to the test article. The coupling between the test article and central shaft must be rigid. Hydraulically controlled loads are transmitted via the load disc and the central shaft to the main shaft of the test article. For outer support of the hydraulically induced forces a massive load reaction block is used. In order to control required loads the system is equipped with a special shaft in front of the central shaft to measure and calculate applied forces and moments near the interface of the test article. Due to massive shaft deflection, a flexible coupling will be used between the central shaft of the load application system and the drive shaft of the speed reducer gearbox.

By utilizing the blade force simulation system the following demands can be met:








- ✓ Simulation of normal and fatigue loads resulting from recurrent structural loading conditions
- ✓ Simulation of ultimate and extreme loads (Rare external design conditions)
- ✓ Simultaneous application of all 6 loads

- ✓ Application of all 6 loads with different frequencies
- ✓ Application of all 6 loads with different magnitudes

The following sensing capabilities will be available:

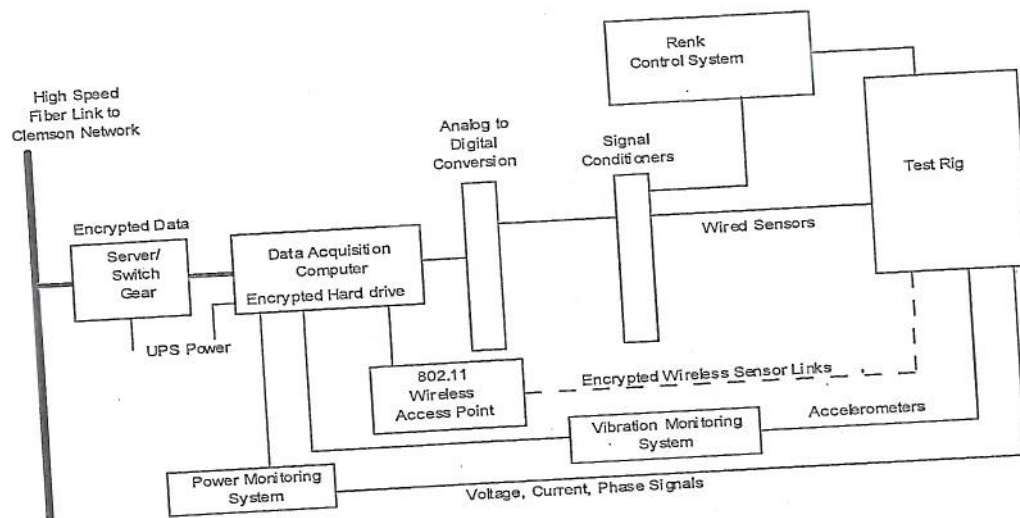
- Temperature
- Vibration
- Acoustic
- Deformation
- Lube Oil Analysis
- Power Losses
- Climatic Behavior
- Grid Interactions

The detailed requirements for monitoring the specimen and the test plan will be developed in conjunction with the customer to meet individual needs. Testing capabilities of the rigs are shown in the table below. More detail information on the Test Rigs is shown in Appendix C of the Project Management Plan.

Testing possibilities (examples)	Test Rig 1 (15 MW): Drivetrain test rig	Test Rig 2 (7.5 MW): Components test rig
Nacelles		
Complete drivetrains		
Gearboxes		
High speed generators		
Direct drive generators	YES	
Load application system	YES	
Climatic chamber + acoustic insulation	YES	YES

2.1.5 Data Acquisition, Transmission, and Security

The instrumented test rigs will generate significant data pertaining to the dynamic response of the test article. Data collection is expected to include loading conditions, lubricant condition, shaft deflection, vibration measurements, shaft torsion and bending responses, thermal measurements as well as other customer defined parameters. The test facility will have an independent Data Acquisition System (DAS) for each of the two test bays. In addition, a third data acquisition system will be built to validate the proper connection of sensors and instrument to test rigs being prepared prior to installation of the test bays. The third system will be portable and compact and used only to evaluate sensor/instrument connections to the test rig. The data recorded from the test rigs is considered to be proprietary for the wind turbine vendors since new prototype models are anticipated to be tested. Data security is therefore considered essential. Vendors will want real time access to the data from the potentially several weeks-to-month test duration. A block diagram of the data acquisition systems for the test rigs is shown below. Wire and wireless sensors will connect to the test rig and be stored and displayed in real time on a dedicated data acquisition computer. Data will be continuously dumped to the Clemson 10 Gbps fiber network after encryption. A virtual private network will be used to tunnel the data only to the vendor whose wind turbine is being tested. The data acquisition system hard drive will be fully encrypted. The wireless sensor signal will also be encrypted.



Data Acquisition System Block Diagram

The computer data acquisition system (DAS) will be backed by uninterruptible power sources. Each test rig data acquisition system will have a 750-channel capacity, a combination of strain sensors, temperature sensors, pressure sensors, shaft speed and acoustic monitoring channels. Speed and torque sensor signals from the Renk Labeco Test Systems control system will be monitored and stored. The design of the DAS will be such that it can be easily expanded for future additions to the facility. Channel capacity has been sized in anticipation that the turbine vendors will embed sensors into the assemblies that will need to be monitored during the testing. A stand-alone power monitoring system for power input and output to the test cell will include voltage, current, and phase measurements. A stand-alone vibration monitoring system will monitor the test rig's rotating equipment. Both the power monitoring and vibration monitoring system will connect to the DAS computer. The DAS will provide overall monitoring of the test via graphical interface on large screen displays. The DAS will be designed for easy use by the wind turbine vendors, allowing them to configure channels, sample rates, storage and encryption for their tests.

The Savannah River National Laboratory (SRNL) will partner with Clemson on the design and security of the DAS. Detailed cost breakdown of the proposed system is shown in Appendix G of the Project Management Plan.

2.1.6 Accreditation of Facility

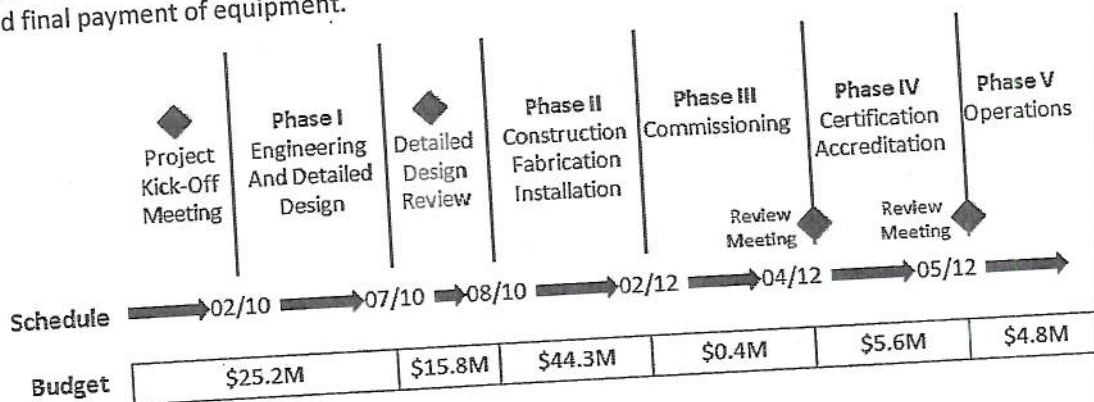
Independent accreditation of the facility will be completed before conducting customer certification testing. The American Association for Laboratory Accreditation (A2LA) is a nonprofit, non-governmental, public service, membership society that provides comprehensive services in accreditation and accreditation-related training. A2LA offers training programs on a regular basis that key personnel will participate in. Renk Labeco Test Systems will be responsible for the certification of the facility through Germanischer Lloyd, TUV SUD America Inc., or UL. For example, TUV SUD is a globally recognized testing, inspection and certification organization and is a Nationally Recognized Testing Laboratory (NRTL). TUV SUD uses the ISO 9001 auditing process. They have experience in the accreditation of large power plants with large turbines and drives utilizing similar equipment that will be installed in the wind turbine drivetrain testing facility. Clemson University will work with the Industrial Advisory Board, Technical Advisory Board, Renk Labeco Test Systems and SRNL in selecting the best agency for certification.

3.0 CRITERION 2: Proposed Method or Approach

3.1 Multiphase Plan and Budget

It is recognized that the wind industry is in need of a facility to test large wind turbine drivetrains in the US. It is also recognized that this facility will operate under a 'shared' model and must be readily accessible to the industry, academia, government agencies, and other entities that have a vested interest in the wind industry. The facility must be state-of-the-art, offering capabilities such as blade force simulation, that are not currently available. Finally, it is recognized that the proposed facility must be realizable and sustainable. With the above in mind, a detailed management plan covering all aspects of the project including the formation of advisory boards has been developed and can be found in the Project Management Plan. A detailed Project Gantt chart can be found in Appendix A of the Project Management Plan that shows key task completion dates.

The Project Management Plan has been set up in five phases and four critical stage gates including a Project Kick-off Review, Detailed Design Review, Commissioning Review and Certification and Accreditation Review prior to moving into full Operations (Phase V) as shown below. This model employs a stage gate approach to ensure budget control and that project deliverables are met. The detailed milestones and deliverables for each Phase are outlined in the Project Management Plan. The project budget is shown below broken down by Phases, in the Project Management Plan under the Business Pro forma and the attached 424 form. The initial funds allocated under Phase I will be targeted for ordering of large lead-time items including motors and cranes. Detailed Design Review funds will be cut post the review to initiate the fabrication of the equipment. Phase II funds are focused on building modifications, infrastructure and equipment fabrication. Phase IV covers Certification and Accreditation and final payment of equipment.



Project Management Phases

Successful management and execution of the Project is dependent upon a seamless transition from each of the Project Phases with key milestones and reviews in place to ensure the Facility will meet customer needs. This requires coordination of activities between Clemson University, City of North Charleston, Charleston Naval Complex Redevelopment Authority, Savannah River National Laboratory and industrial contractors. An external Project Manager (PM) with significant project management experience will be engaged as a temporary grant employee through the first four phases of the project to ensure a seamless, cost efficient project is executed to meet the targeted deadlines. Reporting to the PM will be a dedicated Project Controller to ensure fiscal responsibility and the Project Safety Manager to oversee the establishment of a solid culture of safety and environmental stewardship.

Two advisory boards will be formed composed of experts from industry, academia, and government. The function of these boards will be to ensure that the facility provides equitable access to all users and addresses the industry's current and future needs. The Industrial Advisory Board will advise the facility manager on technical and procedural improvements to the facility to maintain its primary mission of providing high-value/high-quality/cost competitive testing services to the industry. The Technical Advisory Board role will be to provide technical input to the facility and oversee the secondary missions of research and education. Both Boards will be formed within the first three months of the project and be present for the Project Kick-off Meeting, Detailed Design Review, Commissioning Review and Accreditation Review Meetings. An Annual Facility Review will be held at the site for both boards to review the Facility's past year's performance, policies, procedures, and new capabilities needs with the goal of promoting continuous improvement in services. To reduce the cost of travel to the site, Board Members will have the option to attend any meeting via the Video Conferencing system at the CCC next to Building 69.

3.2 Business Plan for Long Term Sustainability

The long-term success of CU WTDTF depends on the development of a strategic plan that encompasses a sustainable business model, a marketing plan, and a strategy to engage the extended enterprise including governmental laboratories and state agencies. All of this must be placed on a foundation of guiding values based on integrity and commitment to quality, strategic relevance, shared objectives and a "living collaboration model."

Development of CU WTDTF Strategic Plan



The financial sustainability of the facility is based on the development of a service-oriented culture coupled with a reputation for delivering high quality/high value/high integrity test and analytical services to the wind industry at a competitive price to accelerate development of new drivetrain technology that will increase reliability and reduce the Cost of Energy (COE) delivered.

The wind industry has seen rapid growth over the past 5 years. 8,500MW of new capacity was installed in the US in 2008 pumping more than \$17 Bn into the economy. The current growth of the US wind industry is already exceeding projections and is on track to reach the projected 16,000MW/year by 2018 targeted in the 20% Wind by 2030 Scenarioⁱⁱⁱ. With the rapid growth of the US market, competition for

supply of wind turbines to the market has increased as well. In 2005, the top two wind turbine manufacturers dominated 90% of the US market with three wind turbine manufacturers accounting for the remaining 10%. Only three years later the same top two wind turbine manufacturers held 55% of the US market with nine turbine manufacturers serving the US demand^{iv}.

Turbine sizes have grown steadily over the past 10 years with more rapid increases realized in the past three years from an average of 1.42MW in 2005 to 1.67MW in 2008^{iv}. Larger turbines are also needed for the emergence of the offshore wind industry to reduce the COE where installed cost can be 30-50% higher than land based wind farms^v. As the demand for larger more efficient wind turbines increases so does the need for reliability. The reliability of a wind turbine drives (1) the operation and maintenance costs, (2) the wind farm's Net Capacity Factor (NCF) and (3) the financial risk associated with the project meeting its financial returns. This has become evident over the past year as credit markets became tight. Per discussions with GE Capital, Fortis Bank and Morgan Stanley, financing of projects deploying wind turbines that have a strong reliability history is at a lower cost and preferable than projects proposed with turbines that have less field service and a proven reliability history.

Historically drivetrains and gearboxes have had the most impact on the reliability of a wind turbine. Unfortunately, for both the manufacturer and owner of the wind turbine; this may not become evident until six or more years after deployment in the field. With increasing deployment of wind turbines in the field, testing and understanding the reliability of a drivetrain is important to reducing the risk of failure several years out. This risk can be a significant cost to the manufacturer in repairs given the number of turbines deployed, damage to reputation in the market and cause revenue losses for the wind farm operator.

Introducing a new turbine design can cost a company \$20-40 M and many years of development before the product is introduced into the market^{iv}. The high cost of new product introduction and the risk associated with discovering reliability issues after commercialization and deployment support the need for HALT. Given the growing competition in the industry, the increasing demand for larger land-based turbines, the push for lower COE and the emergence of the offshore wind industry in the US; the need for facilities to conduct HALT will grow. To address this need, wind turbine manufacturers have the choice of (1) building 'dedicated' test facilities to meet both manufacturing and development needs, (2) building 'dedicated' test facilities to meet manufacturing needs and utilizing a 'shared' facility with greater capability for research and development or (3) utilizing a shared facility to meet both needs. To compare these options three Business Cases were developed and described in detail in Section 5.0 of the Project Management Plan and shown in Appendix L. These Business Cases include (1) Shared Facility, (2) Dedicated Facility with Blade Force Simulator and (3) Dedicated Facility without Blade Force Simulator. The model inputs were based on the estimates received in developing the CU WDTDF budget. In all three models including the 'Shared' and 'Dedicated' facility cases, the weekly facility charge for each test rig was based on the estimated cost of capital and operating cost. In all cases, the cost for the electrical energy to run the tests was not included since it is considered consistent amongst all business cases. Results from these models are summarized below.

(\$\$/week of use)		Year 5	Year 10
Shared Facility Model	Rig #1 with BFS	\$32.9K	\$40.6K
	Rig #2 without BFS	\$16.4K	\$20.3K
Dedicated Facility Model	Test Rig with BFS	\$67.3K	\$53.1K
	Test without BFS	\$34.6K	\$20.4K

When comparing the 'Shared' facility model and the 'Dedicated' facility models, it is evident that 'Dedicated' facilities require a significant upfront capital cost to the turbine and drivetrain manufacturers. This upfront capital cost for a 'dedicated' test facility is significant enough that it could prove to be a barrier to entry for new technology entrants into the market that do not have the financial resources of the major OEMs. The 'Shared' facility model provides equitable access to state-of-the-art test facilities to all industry players supporting development of novel technology to reduce the COE delivered by wind turbines. Comparing estimated weekly costs to operate the test rigs; it becomes evident again that the lower cost option is for a 'Shared' facility versus a 'Dedicated' facility. The 'shared' facility model has the added value of utilization on an as needed basis and access to additional technical, analytic and support services.

The high cost of building a dedicated facility was confirmed through discussions with turbine manufacturers including GE Energy, Acciona, Winergy, Nordex and Clipper. During these discussions, all manufacturers stated that a HALT facility is important for the growth of the industry but a 'shared' facility must be cost competitive versus the 'dedicated' model. The 'Shared' facility model provides equitable access to state-of-the-art test facilities to all industry players supporting development of novel technology to reduce the COE delivered by wind turbines.

The weekly charges for the test rigs will be set on a three year rolling budget. Adjustments will be made to the weekly charge schedule for each rig on an annual basis to reflect the past year budget performance and projected next year budget. Given the significant capability differences between the proposed Test Rig #1 and Test Rig #2, weekly test charges for the large 15MW rig with a blade-force simulator are set higher than the charges for the 7.5MW test rig. The facility is being designed to allow for maximum utilization of the test rigs with three preparation and breakdown areas. Additional space is available near the Facility at CMMC to store or prepare test units. Scheduling of the facility will be on a first come first serve basis with a lottery system used if more than one customer is seeking the same time slot for testing.

The value the CU WTDTF brings to the industry includes:

- Accessibility to state-of-the-art HALT facilities at a lower cost than a 'dedicated' facility
- Lowering the cost of new product development
- Confidentiality and security in testing
- Complimentary analytical resources
- Access to broad range of technical knowledge and computing capability

The CU WTDTF will be operated in a safe, sound and sustainable business approach designed to service the wind industry's need. The key elements include:

- ✓ **Competitive HALT Costs:** The operating structure will retain a high-value/low-cost model making the use of the facility cost competitive for a high level of center utilization by all companies.
- ✓ **Private Company Acceptance and Confidentiality:** The non-profit structure will minimize concerns over competition and opens the facility to all wind drivetrain manufacturers to advance the state of the design and technology.
- ✓ **Sustainability:** Clemson University commits to maintain and operate the facility for a term of not-less-than 20 years.

3.3 Plan to Promote and Develop a Customer Base

The Business Plan for sustainable operations is supported by the following Marketing Objectives:

- Ensure a minimum of 75% utilization
- Develop global awareness of CU WTDTF
- Establish and maintain marketing program including web site development, trade show presence and individual customer visits
- Develop and maintain excellent relationships with State and Local Governments
- Engage all stakeholders in developing a shared objective.

The core elements of the marketing plan include creating a 'brand' for CU WTDTF as part of a greater wind energy initiative. This branding effort will leverage the uniqueness and relevancy of the testing facility but also the core engineering competencies of Clemson University. Marketing materials highlighting the capabilities of the facility, local infrastructure and engineering test services offered will be developed. Specific actions will include regular industry assessment to keep up with new trends and players in drivetrain development and manufacturing, and relationship management with clients and the extended enterprise. Further elements will include web site development to highlight facility capabilities and uniqueness, as well as latest trends and research, direct mail, industry/trade conference participation and onsite facility presentations. CURI facilities will be used to hold trade conferences and technical meetings. Community outreach to ensure support will be undertaken. Relationship management with customers will be a joint responsibility of the Technical Staff, the Business Development Manager, Technical Sales Manager and the Facility Manager.

3.4 Plan to Allow Easy Access to the Facility and Disposition of Intellectual Property

Building 69 is a single story ground floor access structure that will be ADA compliant. The CU WTDTF will be self-contained with workrooms, break areas, and administrative and technical support office areas. Two offices are planned for client representatives. The CCC is located directly across the street from the CU WTDTF facility and contains a video conference room, fully equipped smart classroom, additional office and break rooms, as well as materials analysis and characterization instrumentation. A second planned building on the CURI campus within walking distance will contain office space, support laboratory space, as well as an auditorium.

The CURI campus in North Charleston is in very close proximity to a variety of food vendors, including national chain and local restaurants and catering. Within five miles of the CU WTDTF facility, more than 4,000 accommodations are available in the cities of North Charleston and Charleston as well as entertainment complexes and one of the largest historic districts in the US.

Clemson University plans to enter into a Master Services Agreement with other entities as necessary for the delivery of testing services that is structured to preserve the customer's intellectual property. Task orders will be issued under each Master Services Agreement identifying the testing services, deliverables, protocol and any unique requirements. Clemson proposes to allocate rights to intellectual property arising as a result of the testing conducted at the testing facility in accordance with established terms and conditions that are documented in standard contracting templates developed to address both commercial and sponsored/non-commercial intellectual property resulting from the use of the testing facility. Customer shall own the rights to all Results and any inventions conceived as a result of CU's access to Customer's confidential or proprietary information and materials provided in connection with and specifically for the testing services. All Customer or third party owned background intellectual property, materials and information provided to CU for the purpose of conducting the services will remain the property of Customer and/or third party. The terms and conditions outlined in the templates may be altered to accommodate unique circumstances. Detailed descriptions of the proposed IP plan are described in Section 6.0 of the Project Management Plan.

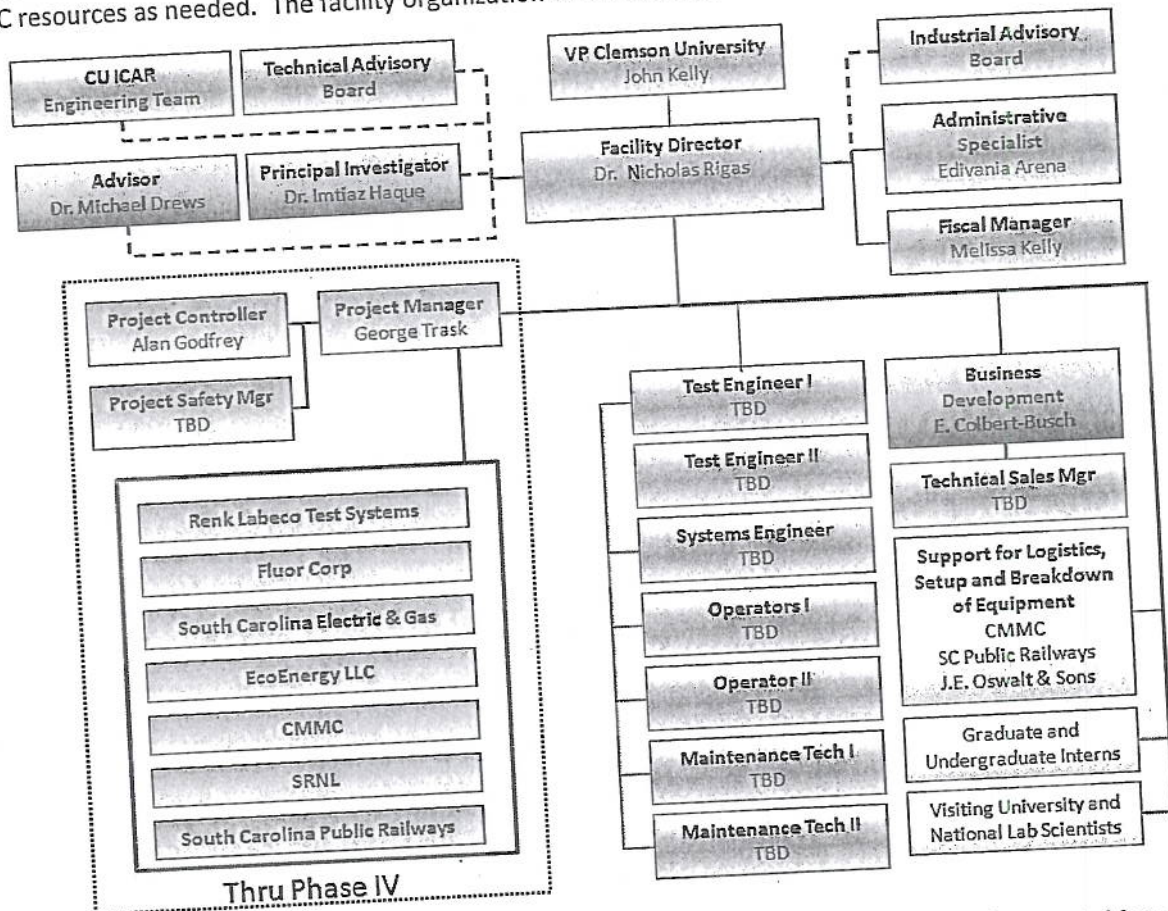
4.0 CRITERION 3: Roles, Responsibilities, and Capabilities

4.1 Adequacy of Resources to Accommodate the Proposed Project

The partners and vendors selected for the project have extensive experience and resources to execute the project. A manpower and staffing plan to execute the project and continue sustainable operations past the proposal period has been developed. Clemson University intends to expand its wind energy portfolio at CURI extensively through the hiring of top researchers and educators. Physical facilities for the expansion are significant including Building 1824 that is intended to house research and support facilities.

4.2 Organizational Structure

The Project is managed by a Facility Director, who will be assisted by a Project Manager through Phase IV. The Facility Director and Project Manager oversee all aspects of the Project including designated specialists in EH&S, Cost Control, Administration, Design and Engineering, Construction, Commissioning, Accreditation, Certification and Operations. The Facility Director will be assisted by University Advisors, Administrative Specialist, Project Controller, Project Safety Manager, and other CU, CUICAR, CURI and CCC resources as needed. The facility organization chart is shown below.



Key staff including PI, Facility Director, Administrative Specialist, Business Development Manager, Advisor, Project Manager, Project Controller, Project Safety Manager (TBD), and CUICAR Engineering Team will be in place from Phase I through Phase V. The Test Engineers, Technical Sales Manager, and

Systems Engineer will be on board by Year 2 with all remaining personal on board by Year 3 to facilitate training and transition of the facility into Operations. The roles and responsibilities of the key personnel are further described in the Project Management Plan.

4.3 Capabilities of Applicants

Clemson University founded in 1889 is ranked 22nd in the nation's top public universities. It has over 4000 employees and 17,500 students and very strong educational and research programs in engineering and science, business, health, education and human development, arts, architecture, and agriculture and life sciences. Clemson University has considerable experience developing unique off-campus public-private partnerships that serve academic, governmental and industry needs. This experience is exemplified in the development of the Clemson University International Center for Automotive Research (CUICAR), and the Advanced Materials Center (AMC).

Clemson University International Center for Automotive Research (CUICAR) is an automotive industry focused campus located in Greenville, South Carolina. It includes faculty, post doctorates, and students engaged in cutting edge research with industry and government sponsors, offers MS and PhD programs in Automotive Engineering, and provides commercial grade test facilities, including drivetrain dynamometer testing for the testing and evaluation of automobiles and their sub-systems. CUICAR includes a major high-speed computation center (Clemson University Computational Center for Mobility Systems (CU-CCMS)) that offers unique capabilities in engineering simulation to clients in the automotive, aviation, and energy industries. The high-speed computational capabilities of the center rank in the top 100 of all computer systems in the world and this capability is available to industry on a commercial basis. The CUICAR campus currently has two major corporations co-located on 250 acres with over 24 additional corporate partners. Investment in this campus over the past six years has exceeded \$200 million. Industry relevance and engagement is achieved through a business and marketing plan that conducts regular industry assessment, provides unique professional development opportunities, and utilizes an industrial advisory board to evaluate current initiatives and provide strategic guidance on new directions.

The CU Advanced Materials Center located in Anderson, South Carolina is an innovative campus and technology park with the Advanced Materials Research Laboratory (AMRL) as the epicenter. It houses faculty, researchers, and students conducting state-of-the-art research in advanced materials, and houses an extensive Electron Microscope testing facility for use by industry on a commercial basis. This electron microscope facility designed and supplied by Hitachi Corporation is the most advanced facility of its kind at an academic institution in the U.S. The facility is used by major companies from different industry sectors for materials testing and analysis. A new Innovation Center, funded through a public-private partnership, is a 28,000-square-foot facility that will house fledgling high-technology companies that focus on such advanced materials as photonics (the practical application of light), nanotechnology (atom-sized technology) and biomaterials. It will provide space for entrepreneurial start-ups, Clemson University spin-off companies, and for larger companies considering relocating to South Carolina.

The Clemson University Restoration Institute (CURI) was established in 2004 to drive economic growth by creating, developing, and fostering restoration industries and environmentally sustainable technologies in South Carolina. The institute is located on 86 acres on the Charleston Naval Complex in North Charleston. CURI is actively engaged in research and economic development activities, building on a very successful Clemson model of developing public-private partnerships. Faculty and students at CURI are engaged in research in the areas of renewable energy focused on bio-based and wind energy systems, development of a resilient infrastructure that ensures sustainability in the coastal environment,

advanced materials, and restoration ecology. The Clemson University Restoration Institute is positioned in the heart of the Charleston Naval Complex forming a unique Industry/Education environment along the coast. CURI has taken the lead for the past four years to promote the development of offshore wind power in South Carolina and is currently conducting collaborative offshore wind research with Santee Cooper to identify suitable locations for wind farms. In the future, Clemson University plans to develop an Innovation Center devoted to wind energy research situated in Bldg. 1824 adjacent to the CU WDTDF. This center will house faculty, staff, and graduate students, offices for visiting researchers and scientists, as well as component testing and simulation facilities.

Partners and Subcontractors

The partners chosen for this project includes CU, CURI, the Cities of North Charleston and Charleston, the Charleston Naval Complex Redevelopment Authority, the Savannah River National Laboratory and the State of South Carolina. Industrial contractors include the Renk Labeco Test Systems, Fluor Corp., South Carolina Electric & Gas (SCE&G), Charleston Marine Manufacturing Company (CMMC), EcoEnergy LLC, South Carolina Public Railways, and the South Carolina State Ports Authority. All team players has a proven record of industry-university collaboration, experience in developing state of the art facilities, as well as the knowledge and skills to design, build, operate and maintain the proposed facility.

The Savannah River National Laboratory (SRNL) will provide direct technical assistance in the design, specification, integration, configuration, and deployment of a high fidelity and custom Data Acquisition System (DAS). The system design will be based upon SRNL's expertise in high fidelity test and data acquisition systems used for nuclear weapons components stockpile surety testing. SRNL staff has specific expertise in custom test and data system architecture and integration for the Department of Energy's National Nuclear Security Agency. This expertise will be utilized to ensure the successful operation and delivery of quality, secure test data to the customer.

Renk Labeco Test Systems is a world renowned engineering company that has been focused on test cell manufacturing since 1986 providing drivetrain test systems for the automotive, marine, aircraft, military and rail industries around the world. Renk Test Labeco was established in Indiana in 1943 to supply automotive and aerospace industries with test stands. Renk AG purchased Labeco in 2000 and formed Renk-Labeco Test Systems Corporation. Renk-Labeco has 290 test systems in operation around the world.

Fluor is a Fortune 500 company that delivers engineering, procurement, construction, maintenance (EPCM), and project management to clients in diverse industries around the world. Fluor develops and implements innovative solutions for complex project issues in diverse industries, including chemicals and petrochemicals, commercial and institutional (C&I), government services, life sciences, manufacturing, mining, oil and gas, power, renewable energy, telecommunications, and transportation infrastructure. Fluor is currently building the Greater Gabbard Offshore Wind Park in the U.K. Fluor has a long standing relationship with Clemson University and is a major employer of Clemson graduates.

SCE&G is the principal subsidiary of SCANA Corporation, a \$10 billion Fortune 500 energy-based holding company, whose businesses include regulated electric and natural gas utility operations, telecommunications and other non-regulated energy-related businesses. SCE&G provides utility services to the Charleston Area including the Charleston Naval Complex.

EcoEnergy LLC is the affiliate electrical engineering and wind development company of the Morse Group. EcoEnergy Engineering has provided critical path electrical engineering to the energy industry

since 1998. EcoEnergy provides project development and engineering and construction management services to energy and wind farm projects.

In summary, Clemson University's experience in the development of unique public-private partnerships as demonstrated in CUICAR, CCC and AMRL, and now proposed for the CURI campus, ensures the ability to comprehensively address all aspects of the project. The presence of Dr. John Kelly, Vice President of Public Services Administration and Director of CURI on the campus will ensure engaged leadership and focused execution of the project. In addition the partnerships and the choice of contractors will ensure that the facility is delivered on time, on budget, and sustainable in the long term. The project's presence on the CURI campus leverages Clemson University's significant research expertise in the areas of advanced materials and their use in challenging environments, automatic controls, drivetrain performance, and computational methods and sensing technology, current research in wind energy, and its experience in managing state-of-the-art test facilities. It ensures the development of an engaged and relevant workforce that can meet the needs of the industry for the long term, ensures the integration of industry with academia and enables very effective technology transfer.

4.4 Level of Participation by Project Participants

This project is benefitted by wide range of support of cash and in-kind cost-sharing gifts from a most impressive array from public and private sectors. Fluor, one of the world's largest engineering, management and construction firms is a collaborator in this project and provided all of the facility modification designs and estimates at no cost. Renk Labeco Test Systems, a US equipment manufacturer and one of the world's finest equipment engineering firms, has provided an educational discount of \$10,000,000 for the drivetrain testing facility equipment. State and local government entities have contributed land, buildings, rail construction, transmission line and cash exceeding \$26 M in cash and in-kind matches. Private individuals have contributed over \$500,000 in cash. Clemson University is fully committed to the success of this project and is contributing \$10.7 M to support this work. Letters of support have been received from GE Energy, Winergy and Nordex, three major players in the wind industry. Strong support has been received from the key stake-holders including environmental groups.

4.5 Applicability of the qualifications and experience of key personnel

Dr. Imtiaz Haque, the PI on the project, has over thirty years of experience with research and education in dynamics of machines including transmissions. He has more than 100 research publications. His recent work has been in the area of continuously variable transmissions. Dr. Haque led the effort in developing and bringing to fruition the drivetrain testing dynamometer facility at CU-ICAR. This included specification development, vendor and equipment selection and installation. He served in a co-leadership role in the development of the CU-ICAR campus that has a total investment of over \$200 M. He was instrumental in the design and construction of the Campbell Graduate Engineering Center and the hiring of the faculty and staff at the Center.

Dr. Nick Rigas has over 15 years of experience in managing industrial operations, capital projects, business development and leading engineering, research and development teams. He served as Managing Director of Technology and Operations for a \$200 M global business with over 150 professional and 400 hourly personnel in research, development, operations, capital projects, logistics and production planning with a > \$110 M annual budget. He managed start-up of Synthetic Intermediates Pilot Plant, Industrial Intermediates Plant, and a Battery Materials Testing Center. He has extensive experience in the wind industry, developing and engineering wind farms and establishing

industrial – university collaborations. He has strong business acumen with a focus on achieving results, serving the customer and promoting innovation to improve efficiency and create value for the business with a solid understanding of establishing a culture of safety and environmental stewardship.

Drs. Haque and Rigas will be supported by Drs Paul Venhovens and Steven Hung and Mr. Mike Messman of CUICAR and Mr. George Trask as the Project manager.

Dr. Paul Venhovens is the BMW chair in Systems Integration. Dr. Venhovens spent 13 years in the automotive industry and is highly experienced in driveline testing, simulation, and data acquisition. He also has broad experience in driveline modeling and validation on a chassis dynamometer.

Dr. Steven Hung is Associate Professor and has 15 years of automotive industry experience as program manager and in research and product development. He has experience with traction control system integration engineering, including dynamometer-level integrated powertrain testing oversight at the F-1 level. His experience with the navy includes development of adaptive/self-tuning controls for propulsion/driveline systems to maximize performance while minimizing undesirable acoustic/vibration emissions.

Mr. Mike Messman is Research Engineer at CU-ICAR. Mr. Messman has 23 years of automotive experience in measurements and testing in support of structural durability, product development, problem solving, and research. He is a renowned expert in fatigue analysis and testing. His current experience is with the chassis dynamometer lab at CU-ICAR.

Mr. George Trask will serve as Project Manager. He has extensive experience in the field. His last experience was as Project Manager for Clemson University International Center for Automotive Research facility that included 5 advanced test cell including a 500 HP Full vehicle chassis dynamometer with a Hemi-Anechoic chamber, and a containerized 500 HP Engine and power train dynamometer with fuel farm.

Dr. John Kelly is Clemson University's Vice President of Public Service Activities and Executive Director of the CURI Campus. He has extensive administrative experience having served in many leadership roles over the last 18 years including 12 years as Vice President. Dr. Kelly manages an annual budget of ~\$95,000,000 and over 800 personnel. He has responsibility for 55 off-campus locations for the university including 8 research and education centers. Dr. Kelly has been directly involved in the construction of 3 new research buildings off-campus in the past 3 years with 2 more in development.

5.0 CRITERION 4: Environmental Considerations

Building 69 is an 82,264 ft² galvanized steel framed building built by the U.S. Navy in 1942. The building was expanded and updated in 1985 with new galvanized siding and a new roof. It was used as a shipping and receiving warehouse for non-hazardous, dry goods. From 1985 through 1995 the building was the central receiving warehouse for the Charleston Naval Complex. An Asbestos Inventory Assessment completed in 1990 by Westinghouse found suspect material in non-friable floor and ceiling floors in the old office area. According to Davis & Floyd, Building 69 is located above the 12 foot NGVD contour elevation at the Naval Complex and therefore above the 100 year floodplain elevation. The facility does not qualify for consideration as a historic structure under the National Register of Historic Places. An endangered plant survey was completed in 1993 by The Citadel, which determined that there were no endangered species. The Sea Purslane, Osprey and Least Tern have been confirmed as residents of the Naval Complex but the proposed facility will not have any adverse impacts. According to the 1988 U.S. Fish and Wildlife Service National Wetland maps, the U.S. Army Corps of Engineers 1988 Wetland

Delineation Survey of the Naval Complex, no wetlands are associated with this facility. Please see submitted Environmental Questionnaire and Appendix J of the Project Management Plan for more details.

6.0 Supplemental Information: American Recovery and Reinvestment Act of 2009, P.L. 111-5 (Recovery Act) Information: It is anticipated that facility over the next 20 years will serve as the catalyst for a wind industry cluster to form at the Naval Complex due to the unique industry/research environment at a brown-field site near existing port, rail infrastructure, and supporting industries. One hundred thirteen (113) temporary jobs associated with the construction of the facility will be created in the first three years, 21 full time jobs are estimated at the facility, another 150 jobs from the manufacturing cluster that will arise around the facility and 568 indirect jobs for a total of 852 jobs during the period of this proposal. Expenditure of funds is outline in Budget Justification File.

7.0 References:

ⁱ US DOE EERE, May 2008, "20% Wind Energy by 2030, Increasing Wind Energy's Contribution to US Electricity Supply".

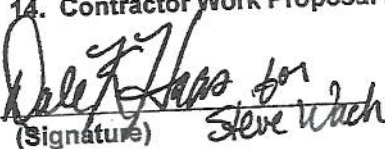
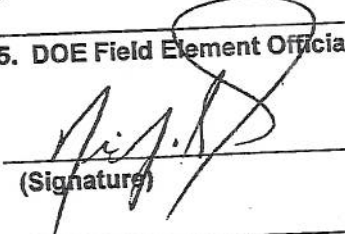
ⁱⁱ W. Musial and S. Butterfield, 2007, "Improving Wind Turbine Gearbox Reliability," 2007 European Wind Energy Conference Milan, Italy.

ⁱⁱⁱ AWEA, 2009, "Annual Statistics on US Wind Energy, Year Ending 2008".

^{iv} R. Wiser and M. Bolinger, July 2009, "2008 Wind Technology Report", US DOE EERE, Lawrence Berkley National Laboratory.

^v D. Bosik, January 2009, "Wind Power Market, Turbine Components & Subcomponents and Demand in the US and World Market", SBI.

U.S. DEPARTMENT OF ENERGY FIELD WORK PROPOSAL

1. Work Proposal Number: EEW-0024	2. Revision Number: 0	3. Date Prepared: 8/20/09
4. Work Proposal Title: Recovery Act: Large Wind Turbine Drivetrain Testing Facility -- DE-FOA-0000112		5. Budget and Reporting Code:
6. Work Proposal Term: Begin <u>10/1/09</u> End <u>9/30/12</u>		
7. Name: (Last, First, MI) (Phone Number) DOE Program Manager Wilson, Sara J. 303-275-4741		8. DOE Organization: Golden Field Office -- DOE Office of Energy Efficiency and Renewable Energy (EERE), Wind and Hydropower Technologies Program (WHTP).
9. DOE Field Element Work Proposal Reviewer: Nixon Peralta		10. DOE Field Element: DOE-SR
11. Contractor Work Proposal Manager: Steve T. Wach		12. Contractor Name: Savannah River Nuclear Solutions, LLC.
13. Proposal Description (Approach, Anticipated Benefit in 200 Words or Less): The Savannah River National Laboratory (SRNL) will provide direct technical assistance in the design, specification, integration, configuration, and deployment of a high fidelity, custom Data Acquisition System (DAS) for the Large Wind Turbine Drive Train Testing Facility. This DAS will monitor the instrumented points of test articles in conjunction with the test facility dynamometers and power systems to give a comprehensive detailed record of drive train performance. The system design will be based upon SRNL's expertise in high fidelity test and data acquisition systems used for nuclear weapons components stockpile surety testing. The scope includes the interface and integration of multiple subsystems into a comprehensive overall facility data system with appropriate firewalls, encryption, and cyber security for safeguarding wind turbine vendor proprietary data. Accreditation testing of the system is not in SRNL's scope and will be performed by others. SRNL staff has specific expertise in custom test and data system architecture and integration for the Department of Energy's National Nuclear Security Agency. This expertise will be utilized to ensure the successful operation and delivery of quality test data for the Drive Train Test Facility.		
14. Contractor Work Proposal Manager:  (Signature) Steve Wach <u>8/20/09</u> (Date)		15. DOE Field Element Official:  (Signature) <u>8/20/09</u> (Date)

16. Detail Attachments: (See Attachments)

- | | | |
|---|---|---|
| <input type="checkbox"/> a. Facility Requirements | <input type="checkbox"/> f. Technical progress | <input type="checkbox"/> k. Deliverables |
| <input type="checkbox"/> b. Publications | <input type="checkbox"/> g. Future Accomplishments | <input type="checkbox"/> l. Perform measures/expectations |
| <input type="checkbox"/> c. Purpose | <input type="checkbox"/> h. Relationships to Other Projects | <input type="checkbox"/> m. ES&H Considerations |
| <input type="checkbox"/> d. Background | <input type="checkbox"/> i. NEPA Requirements | <input type="checkbox"/> n. Human/Animal Subjects |
| <input type="checkbox"/> e. Approach | <input type="checkbox"/> j. Milestones | <input type="checkbox"/> o. Other (Specify) |

WORK PROPOSAL REQUIREMENTS FOR OPERATING/EQUIPMENT OBLIGATIONS AND COSTS

Contractor Name: Savannah River Nuclear Solutions, LLC.			Work Proposal #: EEW-0024		Rev. No.: 0		Date Prepared:	
	Prior Years	BY -1	Budget Year		BY + 1	BY + 2	Total to Complete	
17. Staffing (staff years):			<u>Request</u>	<u>Authorized</u>				
a. Scientific			0.9 FTE		3.2 FTE	1.0 FTE	5.1 FTE	
b. Other Direct								
c. Total Direct			0.9 FTE		3.2 FTE	1.0 FTE	5.1 FTE	
18. Operating Expense:								
a. Total Obligations								
b. Total Costs			\$385K		\$1,220K	\$397K	\$2,002K	
19. Equipment:								
a. Equipment Obligations								
b. Equipment Costs			\$0K		\$0K	\$0K	\$0K	
20. Milestone Schedule:		<u>Proposed</u>				<u>Authorized</u>		
21. Reporting Requirements (Description):								

Grant Application Package

Opportunity Title:	Recovery Act: Large Wind Turbine Drivetrain Testing
Offering Agency:	Golden Field Office
CFDA Number:	81.087
CFDA Description:	Renewable Energy Research and Development
Opportunity Number:	DE-FOA-0000112
Competition ID:	
Opportunity Open Date:	06/23/2009
Opportunity Close Date:	08/25/2009
Agency Contact:	Pamela Brodie procurement specialist

This electronic grants application is intended to be used to apply for the specific Federal funding opportunity referenced here.

If the Federal funding opportunity listed is not the opportunity for which you want to apply, close this application package by clicking on the "Cancel" button at the top of this screen. You will then need to locate the correct Federal funding opportunity, download its application and then apply.

This opportunity is only open to organizations, applicants who are submitting grant applications on behalf of a company, state, local or tribal government, academia, or other type of organization.

* Application Filing Name: CUWTDIF PROPOSAL

Mandatory Documents

Move Form to Complete

Move Form to Delete

Mandatory Documents for Submission

Application for Federal Assistance (SF-424)
Other Attachments Form
Project/Performance Site Location(s)

Optional Documents

Move Form to Submission List

Move Form to Delete

Optional Documents for Submission

Disclosure of Lobbying Activities (SF-LLL)

Instructions

- 1 Enter a name for the application in the Application Filing Name field.
 - This application can be completed in its entirety offline; however, you will need to login to the Grants.gov website during the submission process.
 - You can save your application at any time by clicking the "Save" button at the top of your screen.
 - The "Save & Submit" button will not be functional until all required data fields in the application are completed and you clicked on the "Check Package for Errors" button and confirmed all data required data fields are completed.
- 2 Open and complete all of the documents listed in the "Mandatory Documents" box. Complete the SF-424 form first.
 - It is recommended that the SF-424 form be the first form completed for the application package. Data entered on the SF-424 will populate data fields in other mandatory and optional forms and the user cannot enter data in these fields.
 - The forms listed in the "Mandatory Documents" box and "Optional Documents" may be predefined forms, such as SF-424, forms where a document needs to be attached, such as the Project Narrative or a combination of both. "Mandatory Documents" are required for this application. "Optional Documents" can be used to provide additional support for this application or may be required for specific types of grant activity. Reference the application package instructions for more information regarding "Optional Documents".
 - To open and complete a form, simply click on the form's name to select the item and then click on the => button. This will move the document to the appropriate "Documents for Submission" box and the form will be automatically added to your application package. To view the form, scroll down the screen or select the form name and click on the "Open Form" button to begin completing the required data fields. To remove a form/document from the "Documents for Submission" box, click the document name to select it, and then click the <= button. This will return the form/document to the "Mandatory Documents" or "Optional Documents" box.
 - All documents listed in the "Mandatory Documents" box must be moved to the "Mandatory Documents for Submission" box. When you open a required form, the fields which must be completed are highlighted in yellow with a red border. Optional fields and completed fields are displayed in white. If you enter invalid or incomplete information in a field, you will receive an error message.
- 3 Click the "Save & Submit" button to submit your application to Grants.gov.
 - Once you have properly completed all required documents and attached any required or optional documentation, save the completed application by clicking on the "Save" button.
 - Click on the "Check Package for Errors" button to ensure that you have completed all required data fields. Correct any errors or if none are found, save the application package.
 - The "Save & Submit" button will become active; click on the "Save & Submit" button to begin the application submission process.
 - Follow all onscreen instructions for submission.

Version 02

Application for Federal Assistance SF-424

* 1. Type of Submission: <input type="checkbox"/> Preapplication <input checked="" type="checkbox"/> Application <input type="checkbox"/> Changed/Corrected Application	* 2. Type of Application: <input checked="" type="checkbox"/> New <input type="checkbox"/> Continuation <input type="checkbox"/> Revision	* If Revision, select appropriate letter(s): <input type="text"/> * Other (Specify): <input type="text"/>
--	--	--

* 3. Date Received: Completed by Grants.gov upon submission.	4. Applicant Identifier: <input type="text"/>
5a. Federal Entity Identifier: <input type="text"/>	* 5b. Federal Award Identifier: <input type="text"/>

State Use Only:

6. Date Received by State: <input type="text"/>	7. State Application Identifier: <input type="text"/>
---	---

8. APPLICANT INFORMATION:

* a. Legal Name: <input type="text" value="Clemson University"/>	* c. Organizational DUNS: <input type="text" value="042629816"/>
* b. Employer/Taxpayer Identification Number (EIN/TIN): <input type="text" value="57-6000254"/>	

d. Address:

* Street1:	<input type="text" value="Office of Sponsored Programs"/>
Street2:	<input type="text" value="300 Brackett Hall"/>
* City:	<input type="text" value="Clemson"/>
County:	<input type="text" value="Pickens"/>
* State:	<input type="text" value="SC: South Carolina"/>
Province:	<input type="text"/>
* Country:	<input type="text" value="USA: UNITED STATES"/>
* Zip / Postal Code:	<input type="text" value="29634"/>

e. Organizational Unit:

Department Name: <input type="text" value="CURI"/>	Division Name: <input type="text" value="PSA"/>
---	--

f. Name and contact information of person to be contacted on matters involving this application:

Prefix: <input type="text" value="Mrs."/>	* First Name: <input type="text" value="Lynn"/>
Middle Name: <input type="text"/>	
* Last Name: <input type="text" value="Kunkle"/>	
Suffix: <input type="text"/>	

Title: <input type="text" value="Grants Administrator"/>	
Organizational Affiliation: <input type="text" value="Clemson University"/>	
* Telephone Number: <input type="text" value="864-656-6201"/>	Fax Number: <input type="text" value="864-656-0881"/>
* Email: <input type="text" value="cuosp@clemson.edu"/>	

Version 02

Application for Federal Assistance SF-424

9. Type of Applicant 1: Select Applicant Type:

H: Public/State Controlled Institution of Higher Education

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

* 10. Name of Federal Agency:

Golden Field Office

11. Catalog of Federal Domestic Assistance Number:

81.087

CFDA Title:

Renewable Energy Research and Development

* 12. Funding Opportunity Number:

DE-FOA-0000112

* Title:

Recovery Act: Large Wind Turbine Drivetrain Testing Facility

13. Competition Identification Number:

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

Nation Wide

* 15. Descriptive Title of Applicant's Project:

Clemson University Wind Turbine Drivetrain Test Facility

Attach supporting documents as specified in agency instructions.

Add Attachments

Delete Attachments

View Attachments

Version 02

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant SC-003

* b. Program/Project SC-006

Attach an additional list of Program/Project Congressional Districts if needed.

Add Attachment

Delete Attachment

View Attachment

17. Proposed Project:

* a. Start Date: 01/31/2010

* b. End Date: 01/30/2015

18. Estimated Funding (\$):

* a. Federal	45,000,000.00
* b. Applicant	10,882,005.00
* c. State	26,602,551.00
* d. Local	0.00
* e. Other	13,525,000.00
* f. Program Income	2,824,441.00
* g. TOTAL	98,833,997.00

* 19. Is Application Subject to Review By State Under Executive Order 12372 Process?

- ☐ a. This application was made available to the State under the Executive Order 12372 Process for review on
- ☐ b. Program is subject to E.O. 12372 but has not been selected by the State for review.
- ☒ c. Program is not covered by E.O. 12372.

* 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes", provide explanation.)

☐ Yes ☒ No

Explanation

21. *By signing this application, I certify (1) to the statements contained in the list of certifications** and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 218, Section 1001)

☒ ** I AGREE

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: Dr.

* First Name: Christian

Middle Name: E. G.

* Last Name: Przirembel

Suffix:

* Title: VP for Research & Economic Development

* Telephone Number: 864-656-2424

Fax Number: 864-6565-0881

* Email: cuosp@clermson.edu

* Signature of Authorized Representative:

Completed by Grants.gov upon submission.

* Date Signed: Completed by Grants.gov upon submission.

Version 02

Application for Federal Assistance SF-424

*** Applicant Federal Debt Delinquency Explanation**

The following field should contain an explanation if the Applicant organization is delinquent on any Federal Debt. Maximum number of characters that can be entered is 4,000. Try and avoid extra spaces and carriage returns to maximize the availability of space.

Other Attachment File(s)

* Mandatory Other Attachment Filename:

[Add Mandatory Other Attachment](#)

[Delete Mandatory Other Attachment](#)

[View Mandatory Other Attachment](#)

To add more "Other Attachment" attachments, please use the attachment buttons below.

[Add Optional Other Attachment](#)

[Delete Optional Other Attachment](#)

[View Optional Other Attachment](#)

Project/Performance Site Location(s)

Project/Performance Site Primary Location ☐ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name:

DUNS Number:

* Street1:

Street2:

* City:

County:

* State:

Province:

* Country:

* ZIP / Postal Code:

* Project/ Performance Site Congressional District:

Project/Performance Site Location 1

☐ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name:

DUNS Number:

* Street1:

Street2:

* City:

County:

* State:

Province:

* Country:

* ZIP / Postal Code:

* Project/ Performance Site Congressional District:

DISCLOSURE OF LOBBYING ACTIVITIES

Complete this form to disclose lobbying activities pursuant to 31 U.S.C.1352

Approved by OMB
0348-0046

1. * Type of Federal Action: <input type="checkbox"/> a. contract <input checked="" type="checkbox"/> b. grant <input type="checkbox"/> c. cooperative agreement <input type="checkbox"/> d. loan <input type="checkbox"/> e. loan guarantee <input type="checkbox"/> f. loan insurance	2. * Status of Federal Action: <input checked="" type="checkbox"/> a. bid/offer/application <input type="checkbox"/> b. initial award <input type="checkbox"/> c. post-award	3. * Report Type: <input checked="" type="checkbox"/> a. initial filing <input type="checkbox"/> b. material change
4. Name and Address of Reporting Entity: <input checked="" type="checkbox"/> Prime <input type="checkbox"/> SubAwardee * Name: <input type="text" value="Clemson University - N/A"/> * Street 1: <input type="text" value="300 Brackett Hall"/> Street 2: <input type="text"/> * City: <input type="text" value="Clemson"/> State: <input type="text" value="SC: South Carolina"/> Zip: <input type="text" value="29634"/> Congressional District, if known: <input type="text" value="SC-003"/>		
5. If Reporting Entity in No.4 is Subawardee, Enter Name and Address of Prime: 		
6. * Federal Department/Agency: <input type="text" value="DOE"/>	7. * Federal Program Name/Description: <input type="text" value="Renewable Energy Research and Development"/> CFDA Number, if applicable: <input type="text" value="81.087"/>	
8. Federal Action Number, if known: <input type="text"/>	9. Award Amount, if known: \$ <input type="text"/>	
10. a. Name and Address of Lobbying Registrant: Prefix <input type="text"/> * First Name <input type="text" value="n/a"/> Middle Name <input type="text"/> * Last Name <input type="text" value="n/a"/> Suffix <input type="text"/> * Street 1 <input type="text"/> Street 2 <input type="text"/> * City <input type="text"/> State <input type="text"/> Zip <input type="text"/>		
b. Individual Performing Services (including address if different from No. 10a) Prefix <input type="text"/> * First Name <input type="text" value="n/a"/> Middle Name <input type="text"/> * Last Name <input type="text" value="n/a"/> Suffix <input type="text"/> * Street 1 <input type="text"/> Street 2 <input type="text"/> * City <input type="text"/> State <input type="text"/> Zip <input type="text"/>		
11. Information requested through this form is authorized by title 31 U.S.C. section 1352. This disclosure of lobbying activities is a material representation of fact upon which reliance was placed by the tier above when the transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be reported to the Congress semi-annually and will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure. * Signature: <input type="text" value="Completed on submission to Grants.gov"/> * Name: Prefix <input type="text"/> * First Name <input type="text" value="n/a"/> Middle Name <input type="text"/> * Last Name <input type="text" value="n/a"/> Suffix <input type="text"/> Title: <input type="text"/> Telephone No.: <input type="text"/> Date: <input type="text" value="Completed on submission to Grants.gov"/>		
Federal Use Only: Authorized for Local Reproduction Standard Form - LLL (Rev. 7-97)		

Compliance with the Davis Bacon Act

The Act requires that all contractors and subcontractors performing on federal contracts (and contractors or subcontractors performing on federally assisted contracts under the related Acts) in excess of \$2,000 pay their laborers and mechanics not less than the prevailing wage rates and fringe benefits, as determined by the Secretary of Labor, for corresponding classes of laborers and mechanics employed on similar projects in the area.

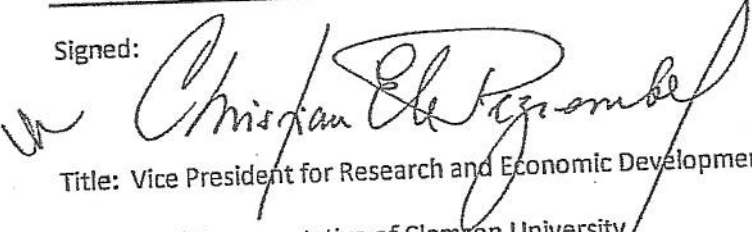
Apprentices and trainees may be employed at less than predetermined rates. Apprentices must be employed pursuant to an apprenticeship program registered with the Department of Labor or with a state apprenticeship agency recognized by the Department. Trainees must be employed pursuant to a training program certified by the Department.

Contractors and subcontractors on prime contracts in excess of \$100,000 are also required, pursuant to the Contract Work Hours and Safety Standards Act, to pay employees one and one-half times their basic rates of pay for all hours over 40 worked on covered contract work in a workweek.

Covered contractors and subcontractors are also required to pay employees weekly and to submit weekly certified payroll records to the contracting agency.

The Clemson University, in execution of DE-FOA-0000112, will comply with all requirements of the Davis Bacon Act.

Signed:


Title: Vice President for Research and Economic Development
Authorized Representative of Clemson University

R&D Laboratory Environmental Impact Questions

This project is for design, construction, and operation of a large scale wind turbine drivetrain test facility. No laboratory work is involved.

In order to receive Federal financial assistance, proposed projects must be reviewed under the National Environmental Policy Act (NEPA) for potential environmental impacts. For research and development activities, the following questions must be sufficiently answered before the review can be completed. Please add as much detail as possible.

1. Please provide and describe the location of the facility or facilities where lab work will take place. N/A

2. What type of safety protocols are in place in the areas where work will take place? Who monitors these? Internally and externally? Are the safety protocols subject to OSHA or other standards? Please describe all safety and environmental protocols and standards related to this project.

The handling of heavy equipment, isolating high energy devices including electrical and mechanical devices will require safety protocols that will be developed to meet OSHA standards.

3. How are the gases, chemicals, heavy metals, etc., handled, stored and disposed?
N/A

4. What type of safety equipment is in place for the facilities (i.e. fume hoods, alarms, scrubbers, etc...)? Fire alarms, sprinkler system and security system

5. What permits are in place for the facility for this type of work? Please list.
Existing Environmental Permits and area zoned for industrial use.

6. What permits are needed or will be acquired for this type of work? Please list.
Building permits from City of North Charleston

7. How is liquid effluent handled and discharged? N/A

8. How is toxic waste handled, stored, and disposed? N/A

9. Will the work being done create any air pollutants? If so please explain how these are regulated, handled, disposed, or mitigated. N/A

10. Are Genetically Modified Organisms (GMOs) being used? If so please describe how these will be transported, stored, handled and disposed? How are these classified by the USDA Animal and Plant Health Inspection Service (APHIS)? N/A

PMC 111.1
(01/08)

11. Will prototypes be tested in a separate location, if so, please describe the location and answer questions #1-9? N/A

12. Are subcontractors being used for some of the work? If so please answer Questions #1-11 for work being completed by subcontractors. N/A

PMC-
EF1

(2/06/02)

U.S. DEPARTMENT OF ENERGY
EERE PROJECT MANAGEMENT CENTER
ENVIRONMENTAL CHECKLIST
(To Be Completed by Potential Recipient)

**PART I: General Information**

DOE Project Officer: Gary Nowakowski Date: 8/6/2009

Project Title: Clemson University Wind Turbine Testing Facility

ST: SC

Organization Name: Clemson University

Solicitation Number: DOE-FOA-0000112

Award No:

1. Please describe the intended use of DOE funding in your proposed project. For example, would the funding be applied to the entire project or only support a phase of the project? Describe the activity as specifically as possible, i.e. planning, feasibility study, design, data analysis, education or outreach activities, construction, capital purchase and/or equipment installation or modification. If the project involves construction, also describe the operation of the completed facility/equipment.

Engineering, procurement, and construction of a Wind Turbine Drivetrain Test Facility in North Charleston, SC located on the Naval Complex (Decommissioned US Navy Facility) gifted to the State of South Carolina in current ownership by the Navy Base Redevelopment Authority pending transfer to Clemson University for this project. Project will be used to design, construct, and commission a wind turbine test facility.

2. Does any part of your project require review and/or permitting by any other federal, state, regional, local, environmental, or regulatory agency? ☒ Yes ☐ No

3. Has any review (e.g., NEPA documentation, permits, agency consultations) been completed?
☐ Yes ☒ No If yes, is a finding or report available and how can a copy be obtained?
 Site has completed extensive environmental review prior to transfer from the Navy to the State of South Carolina and attached herein (pdf file: Environmental69).

4. Is the proposed project part of a larger scope of work? ☒ Yes ☐ No If yes, please describe.
 The testing facility will be completed during this federal grant. However, the facility will be used for years to further allow for testing of large scale wind turbines, traditional research, and development activities.

Do you anticipate requesting additional federal funding for subsequent phases of this project?
☐ Yes ☒ No If yes, please describe.
 No additional project phases impacting the expansion of the facility are anticipated at this time.

5. Does the scope of your project only involve one or more of the following:

- ☐ Information gathering such as literature surveys, inventories, audits,
- ☐ Data analysis including computer modeling,
- ☐ Document preparation such as design, feasibility studies, analytical energy supply and demand studies, or
- ☐ Information dissemination, including document mailings, publication, distribution, training, conferences, and informational programs.

Preparer:
 Melissa Kelley
 Business Contact:
 Imtiaz Haque

Phone:
 864-656-3016
 Phone:
 864-656-5628

Email:
melissk@clemson.edu
 Email:
sih@clemson.edu

PART II: Environmental Considerations

Section A Conditions or special areas are present, required, or could be affected by your project:

3. New or Modified Federal/State Permits And/or Requests for Exemptions

Construction permits required by the City of North Charleston. DHEC review of emissions, chemicals, and waste water will occur during the design stage of the project and be available for review. Facility is a minor emitter and will not require air or wastewater permits. No emissions from test facility, however, land use controls under voluntary clean-up contract would require compliance.

1. Clearing or Excavation

No, the existing building will be retrofit for test facility except for floor slab reinforcement.

2. Dredge and/or Fill.

No, an existing building will be retrofit for testing facility.

4. Pre-Existing Contamination

Yes, decommissioned US Navy Facility but none identified on actual project site. Existing DHEC/EPA brownfield agreement for site.

5. Asbestos

Asbestos survey conducted by Westinghouse revealed no friable suspect materials.

6. Criteria Pollutants

No projected emissions

7. Non-Attainment Areas

Yes, SO₂, Charleston, SC

8. Class I Air Quality Control Region

No

9. Navigable Air Space

No

10. Areas with Special Designation

No

11. Prime, Unique or Important Farmland

No

12. Archeological/Cultural Resources

No

13. Threatened/Endangered

No

14. Other Protected Species

No

15. Floodplains

Yes. Zone and AE. F.E.M.A. Community Panel: 45019C0502J

16. Special Sources of Groundwater

No

17. Underground Extraction/Injection

No

18. Wetlands

No

19. Coastal Zones

Yes

20. Public Issues or Concerns

None

21. Noise

No

22. Depletion of a Non-Renewable Resource

No

23. Aesthetics

No, enclosed in existing building.

Section B. Would your project use, disturb, or produce any chemicals or biological substances? (i.e., pesticides, industrial process, fuels, lubricants, bacteria)**1. Polychlorinated Biphenyls**☐ Permit Required Quantity: Permit Type:

Specific nature of use:

No

2. Import, Manufacture, or Processing of Toxic Substances☐ Permit Required Quantity: Permit Type:

Specific nature of use:

No

3. Chemical Storage, Use, and Disposal☐ Permit Required Quantity: Permit Type:

Specific nature of use:

No

4. Pesticide Use☐ Permit Required Quantity: Permit Type:

Specific nature of use:

No

5. Hazardous, Toxic, or Criteria Pollutant Air Emissions☐ Permit Required Quantity: Permit Type:

Specific nature of use:

No

6. Liquid Effluent☐ Permit Required Quantity: Permit Type:

Specific nature of use:

Yes, wastewater only designed for acceptance to North Charleston sewer. No major contaminants anticipated in waste stream.

7. Underground Extraction/Injection☐ Permit Required Quantity: Permit Type:

Specific nature of use:

No

8. Hazardous Waste☐ Permit Required Quantity: Permit Type:

Specific nature of use:

No

9. Underground Storage Tanks

☐ Permit Required Quantity: Permit Type:

Specific nature of use:

No

10. Biological Materials.

☐ Permit Required Quantity: Permit Type:

Specific nature of use:

No

Section C. Would your project require or produce any radiological materials?

1. Radioactive Mixed Waste

☐ Permit Required Quantity: Permit Type:

Specific nature of use:

None

2. Radioactive Waste

☐ Permit Required Quantity: Permit Type:

Specific nature of use:

None

3. Radiation Exposures

☐ Permit Required Quantity: Permit Type:

Specific nature of use:

None

[Update](#) [Print Form](#) [Return to Main Menu](#)

Letters of Commitment

Name of Organization	Amount Provided	% of Total Project	Type of Cost Share
Charleston Naval Redevelopment Authority	\$6,000,000	6.07%	Cash
Clemson University	\$6,205,000	6.27%	Cash
Clemson University	\$4,677,005	4.73%	Property, Office Space & Unrecovered F&A
James Meadors	\$25,000	<.1%	Cash
RENK	\$10,000,000	10.12%	Discount on Equipment
SC Department of Commerce	\$3,000,000	3.03%	Cash
SC Public Railway	\$366,551	.37%	Services
SCE&G	\$3,000,000	3.03%	Cash
State of South Carolina	\$7,000,000	7.08%	Cash
State Port Authority/RDA	\$10,236,000	10.36%	Property
Tony Bakker	\$500,000	0.5%	Cash

Letters of Support

GE Energy Infrastructure

Nordex

Winergy

James E Clyburn

J. Gresham Barrett

Henry E Brown, Jr.

Bob Inglis

John M Spratt, Jr.

Joe Wilson

Jim DeMint

Lindsey O Graham

Savannah River National Laboratory

SC Energy Office

Beaufort County

Beaufort County Lowcountry Economic Network

Berkeley County

Charleston County

Colleton County

Colleton County Economic Alliance

Dorchester County

Georgetown County

Horry County

Jasper County

Duke Energy

Fluor

CMMC, LLC

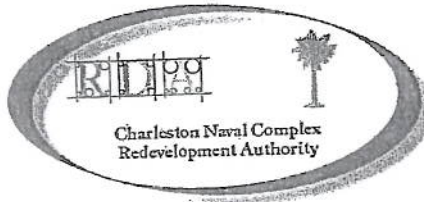
JE Oswald & Sons

Maybank Industries, LLC

Coastal Conservation League

SC Wildlife Federation

Sierra Club of SC



August 25, 2009

Dr. John Kelly
Clemson University
Vice President, PSA
Executive Director, Clemson University Restoration Institute
1360 Truxtun Avenue, Ste., 300 B
North Charleston, South Carolina 29405

Dear Dr. Kelly,

The Authority, at its August 25, 2009 meeting, voted to commit \$6M to Clemson University's Restoration Institute over a term not to exceed four-years if Clemson is awarded U. S. DOE grant DE-FOA-0000112 for the construction of a Large Wind Turbine Drive Train Testing Facility on the former Charleston Naval Complex.

Should you have any further questions, please let me know.

With kind regards,



Robert Ryan
Executive Director



August 24, 2009

Dr. John Kelly
Clemson University
Vice President, PSA
Executive Director, Clemson University Restoration Institute
360 Truxtun Avenue, Suite 300 B
North Charleston, SC 29405-2045

RE: DE-FOA-0000112, Large Wind Turbine Drivetrain Testing Facility

Dear Dr. Kelly:

Clemson University is writing in support of our Clemson University Restoration Institute's (CURI) Large Wind Turbine Drivetrain Testing Facility grant proposal, to be located on CURI's site at the former Charleston Naval Shipyard. As a principal in the consortium, we are excited to see the scope of this project and its potential to create economic opportunities for the state. This project is fitting with our mission in economic development. We continue to be encouraged by the opportunities for job creation CURI's Renewable Energy Research Program brings to our state.

Should DE-FOA-0000112 grant for Clemson University Wind Turbine Drivetrain Test Facility, made possible by the America Recovery and Reinvestment Act, be awarded to Clemson University, we commit to \$6,205,000 in cash and \$4,677,005 in-kind cost sharing for the project.

We look forward to supporting your efforts and the award announcement in October of 2009.

Sincerely,

A handwritten signature in black ink, appearing to read "James F. Barker", followed by a horizontal line.

James F. Barker
President

JFB/la



PRESIDENT

201 Sikes Hall Clemson, SC 29634-5002
864.656.3413 FAX 864.656.4676



MEADORS

RESIDENTIAL

COMMERCIAL

CONSTRUCTION

DESIGN SERVICES

ARTS & CRAFTS

August 12, 2009

Dr. John Kelly
Clemson University
Vice President, PSA
Executive Director, Clemson University Restoration Institute
360 Truxtun Avenue, Suite 300 B
North Charleston, SC 29405-2045

RE: DE - FOA - 0000112: Large Wind Turbine Drivetrain Testing Facility

Dear John,

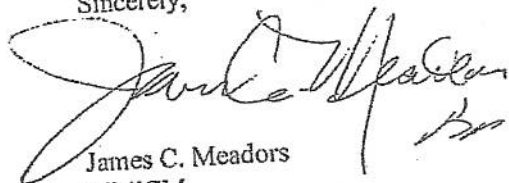
I am writing to you in support of Clemson University's application for federal funding through the Large Wind Turbine Drivetrain Testing Facility program, made possible by the American Recovery and Reinvestment Act of 2009 (ARRA). Not only will this project have a direct impact on job creation and economic development for our local community and our state but, promotes and protects quality of life for our coastal community by delivering services of value to the community.

Should DE-FOA-0000112 grant for Large Turbine Drivetrain Testing Facility, made possible by the America Recovery and Reinvestment Act, be awarded to Clemson University, I commit to raising \$25,000.00 for Clemson University's work. In the event I am unable to raise the entire \$25,000.00, I will personally guarantee the remainder to insure the money I am pledging is received. I am excited to see the scope of this nearly 80 million dollar project and its potential of 650 jobs for our local community. We continue to be encouraged by the opportunities for job creation that CURI's Renewable Energy Research Program brings to our state.

The test facility will serve as the catalyst to establish a wind energy manufacturing cluster at the former Naval Base to bring economic development to the area. As the offshore wind market emerges along the East Coast of the United States and land-based turbines continue to grow in size, South Carolina is strategically positioned to serve as an industrial hub from this growing industry to meet the 20% Wind by 2030 Scenario.

I look forward to supporting your efforts and the award announcement in October of 2009.

Sincerely,


James C. Meadors
Tib/JCM

P.O. Box 21758, Charleston, SC 29413-1758

Tel: (843) 722-8685

Fax: (843) 577-8177

www.meadorsinc.com

100% RECYCLED PAPER - PLEASE RECYCLE

RENK LABECO Test Systems CORPORATION
156 East Harrison Street,
Mooreville, Indiana 46158-1625

Phone: 317-831-2990
Watts: 800-878-2990
Facsimile: 317-831-2978
Email: mail@labeco.com



Quotation-no. 29 000 110-1

Clemson University

Truxton Avenue
North Charleston, SC
USA

Our references	Your contact	Phone	Telefax	E-Mail	Date
RL-JC	Eric Floyd	(+1) 317-831-2990	(+1) 317-831-2978	mail@labeco.com	12 August 2009

Clemson University Wind Turbine Testing Facility
RENK/LABECO-Quotation-No. 29 000 110-1

Dear Sirs,

thank you for your interest in our technology, we are pleased to submit our quotation as follows:

1. 15 MW Wind Turbine and components Test Stand

For the calculation of prices for start up and acceptance testing at the customer site, it is our understanding that the work involved can be carried out smoothly and without any unforeseen interruptions. Work can be performed by RENK as a not union organized company.
If the relevant work should be interrupted and is not related to a fault of RENK/LABECO, or if unionized personal is required, we reserve the right to charge the corresponding waiting period and/or additional travel expenses to customer at cost.

RENK LABECO Test Systems CORPORATION
156 East Harrison Street,
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Email: mail@labeco.com



Quotation-no: 29 000 110-1

2. Pricing

- 2.1 Total price for the 15 MW test system, containing one 7.5 MW motor and drive, one 15 MW@10 rpm gear box, a RDDS control and data acquisition system. Installed to a customer built base slab, and commissioned at site in Charleston
US\$ 11,800,000
 - 2.2 Total price for the dynamic rotor blade force load simulation, containing hydraulic cylinder load application, servo valve operated, served by a hydraulic power plant located next to the test stand. RDDS control and data acquisition system. installed to a customer built base slab, and commissioned at site in Charleston.
US\$ 16,700,000
 - 2.3 Total price for the support structure to above mentioned Components, containing frame work and support structure for the test stand. Installed at site in Charleston to a customer built base slab, Specimen support frames and adapting parts are not included.
US\$ 2,200,000
 - 2.4 Total price for the 7.5 MW test system, containing one 7.5 MW motor and drives, one 7.5 MW@12rpm gear box, a RDDS control and data acquisition system. installed to a customer built base slab, and commissioned at site in Charleston
US\$ 10,600,000
 - 2.5 Total price for the climatic chamber, containing a modularly built chamber for temporary set up, 100kW cooling capacity -20°C max. low temp. at no heat load for cold start testing, +50°C max. high temp, heat generated by gas burner. Ventilation motors and drives and mixer chamber, a control system. installed to a customer built duct system, and commissioned at site in Charleston
US\$ 2,600,000
 - 2.6 Total price for sound separation system, containing one sound cover for the 7.5 MW test stand gearbox and motor and one sound absorbing wall (barrier), approx. 20m x 15m between the test stand and specimen for the 15 MW test stand. Wall side sound absorbing panels in test room to be installed by customer
US\$ 700,000
- | | |
|--|-----------------|
| | US\$ 44,600,000 |
| Educational discount to Clemson University | US\$ 10,000,000 |
| Final Total System Price | US\$ 34,600,000 |

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2.5 Options

Option 1	7.5 MW Motor and drive for power boost to 15MW	US\$	4,300,000
Option 2	Grid simulation	US\$	TBD
Option 3	Transformer and power distribution panel	US\$	TBD
Option 4	Cooling tower, and piping 3MW capacity	US\$	370,000
Price estimate			
Option 5	Calibration equipment for torque measurement	US\$	TBD
Option 6	Acoustic absorption panels for test room	US\$	TBD
Option 7	Ventilation of test rooms, air conditioning of electrical and control room	US\$	TBD
Option 8	Civil engineering and construction of Base slab and foundation.	US\$	TBD
Option 9	Crane with a gross capacity of 300t	US\$	TBD
Option 10	Vibration analyzer, Power electric analyzer	US\$	350,000
Price estimate			
Option 11	Packaging, shipping, moving in	US\$	380,000
Price estimate			
Option 12	3 rd Party certification of test stand (e.g. Germanischer Lloyd, Tüv, UL)	US\$	400,000
Price estimate			

2.3 Pricing, General

The above prices are firm prices. Imported components are based on a exchange rate of \$1.42 / €1.00, in case exchange rate shift more then 1% in any direction prices will be adjusted. Prices do not include any state or sales or import tax.

2.4 Delivery terms

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Quotation no. 29 030 110-1

Ex Works, Renk Labeco Test Systems Corp., Mooresville, IN, USA
Major components might be shipped in from international manufacturers, this shipping and packaging will be charged as per actual.

3. **Delivery time**

The delivery period will be approx. 18 months, ex work Renk Labeco or its major suppliers, after receipt of your technically and commercially clear order and advance payment. Assembly, commissioning and start up will take about 6 to 9 additional month.

4. **Payment terms**

20% after close of contract

30% after critical design review (approx. 6 month after contract date)

20% 14 month after contract date (approx. 50% of construction is completed)

20% at shipment

10% after final acceptance test at customers site, not to exceed 360 days after receipt, if installation and/or final acceptance test is delayed for reasons beyond RENK/LABECO's responsibility.

Net without any deductions, payable within 30 days after date of invoice.

5. **Warranty for new supplied parts**

For 12 months from the date of acceptance, or 24 months from shipment if commissioning of the test stand is delayed for reasons beyond RENK/LABECO's responsibility, RENK/LABECO warrants the equipment to be free from defects in material, workmanship and title. This limited warranty is conditioned upon the equipment being properly cared for and operated under normal conditions and competent supervision. In addition, the warranty is conditional upon the equipment not being modified or altered in any manner.

The software is warranted to conform to RENK/LABECO's published functional specifications. If any persons other than RENK/LABECO alter the software, the warranty is terminated from the date of such alteration.

Warranty for reused or modified parts and components is excluded.

6. **Protective remarks**

Copying of any documents submitted, their disclosure, utilization and communication of the contents thereof are forbidden unless explicitly authorized in writing. All rights are reserved in the event of the granting of a patent or registration of a model or design.

All software developed by RENK/LABECO remains the property of RENK/LABECO and is subject to a Licensee Agreement. Any software supplied by RENK/LABECO as developed on its behalf may only be used for such systems or parts thereof

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delivered by RENK/LABECO and for which the software is intended according to the definition of the purchase order. Any other use or disclosure to third parties in whole or in part is not allowed.

For commercial software programs included in RENK/LABECO's scope of supply, the conditions of the relevant user licenses are valid.

7. **Limitation of Liability**

The parties expressly agree that under no circumstances shall RENK/LABECO be liable to the purchaser for any special, indirect, incidental or consequential damages as a result of any breach under this contract. In addition, the parties expressly agree that RENK/LABECO's total liability to the purchaser whether in contract, in tort, under any warranty or otherwise arising out of the transaction, shall not exceed the price of the product or part on which such liability is based.

The purchaser expressly agrees to indemnify and save harmless RENK/LABECO, its agents, employees, or representatives from and against all loss or expense (including costs and attorney's fees) incurred by reason of liability imposed by law for damages incurred for bodily injury and property damage, including loss of use thereof, arising out of or in consequence of the contract between the parties.

8. **Conditions of contract**

The remaining contractual conditions are in conformity with our "Standard Terms and Conditions of Sale of RENK/LABECO".

If any of the words or provisions of this contract shall be deemed to be invalid for any reason then this contract shall be read as if the invalid provisions had to that extent been deleted there from and the validity of the remaining provisions of this contract shall not be affected thereby.

9. **Validity of the quotation**

This quotation is valid for 90 days.

Should you have any questions please do not hesitate to contact us. We hope our quotation meets your requirements and are looking forward to receiving your order.

Yours faithfully,

RENK LABECO Test system CORPORATION


Mathias Karrer
Board Member


Jörg Cordes
President